Exhibit 1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG DISPLAY CO., LTD.,
Petitioner,

v.

SOLAS OLED, LTD.,
Patent Owner.

Case No. IPR2019-01668
U.S. Patent No. 9,256,311

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,256,311 UNDER 35 U.S.C. §§ 311–319 AND 37 C.F.R. § 42.100 *et seq.*

LIST OF EXHIBITS

Exhibit	Description
1001	U.S. Patent No. 9,256,311 (the "'311 patent")
1002	File History for U.S. Patent No. 9,256,311
1003	U.S. Patent No. 8,722,314 ("Kuriki")
1004	U.S. Patent No. 9,395,851 ("Mikladal")
1005	U.S. Patent Application Pub. No. 2011/0102361 ("Philipp")
1006	U.S. Patent Application Pub. No. 2012/0218219 ("Rappoport")
1007	International Publication No. WO 2010/099132 ("Moran")
1008	U.S. Patent Application Pub. No. 2008/0223708 ("Joo")
1009	International Publication No. WO 2011/107666
1010	U.S. Patent Application Pub. No. 2010/0045632 ("Yilmaz")
1011	Atmel Touch Sensors Design Guide, Rev. E (Sept. 2009)
1012	U.S. Patent Application Pub. No. 20100123670
1013	U.S. Patent Application Pub. No. 20090219257 ("Frey I")
1014	U.S. Patent Application Pub. No. 20100156840 ("Frey II")
1015	U.S. Patent No. 9,400,576 ("Chen")
1016	International Publication No. WO 2011/107665 ("Brown")
1017	International Publication No. WO 2011/062301
1018	*Scalable Coating and Properties of Transparent, Flexible, Silver Nanowire Electrodes*, Hu et al. (Apr. 28, 2010)
1019	U.S. Patent Application Publication No. 20110253668
1020	U.S. Patent Application Publication No. 20110007011
1021	U.S. Patent Application Publication No. 20120111479 ("Sung")
1022	*SmartSkin: An Infrastructure for Freehand Manipulation on Interactive Surfaces*, Rekimoto (Apr. 2002)
1023	Declaration of Dr. Andrew Wolfe
1024	*Curriculum Vitae* of Dr. Andrew Wolfe

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I. INTRODUCTION

Samsung Display Co., Ltd. ("Petitioner") petitions for *inter partes* review seeking cancellation of claims 1–20 of U.S. Patent No. 9,256,311 (Ex. 1001, "'311 patent"), assigned to Solas OLED, Ltd. ("Patent Owner").

The '311 patent relates to capacitive touch sensors for touchscreen devices, which use electrodes that create an electric field and measure changes in capacitance caused by a user's touch, allowing the sensor to determine that touch's location on the screen. Ex. 1001, 1:24–33, 3:31–64. More specifically, it is directed to touch sensors with "mesh" electrodes, composed of a grid of extremely fine metallic lines that appear near-transparent to the human eye (similar to a screen door in a house). *Id.*, 5:56–6:13. These "mesh" electrodes can be laid under protective glass and over a display screen without obstructing a user's view of that underlying display. *Id.*, 8:3–10; Ex. 1023, ¶ 45.

The use of mesh electrodes for capacitive touch sensors was well known in the art. Indeed, during the prosecution of the '311 patent, claims directed to mesh electrodes were repeatedly rejected by the Examiner over the prior art. *See, e.g.*, Ex. 1002 at 68–85 (March 19, 2015 Non-Final Rejection) (discussing "the mesh bars from the touch screen sensor taught by Frey"). Further, U.S. Patent No. 8,722,314 to Kuriki (Ex. 1003) and International Publication No. WO 2010/099132 to Moran

et al. (Ex. 1007) each disclosed mesh electrodes made of the same materials as the electrodes described by the ’311 patent.

To secure allowance of the ’311 patent, the applicants ultimately added a further limitation to the claims: that the touch sensor and the substrate on which it is mounted “wrap around one or more edges of a display.” Ex. 1001, 9:5–7, 9:44–46.

In allowing the claims, however, the Examiner was not apprised of prior art that specifically taught wrapping capacitive touch sensors around the edge of a device’s display screen onto the sides of that device. For instance, U.S. Patent No. 9,395,851 to Mikladal et al. (Ex. 1004) and U.S. Patent Application Pub. No. 2008/0223708 to Joo et al. (Ex. 1008) both disclose wrapping capacitive touch sensors around the edge of a display and explain numerous benefits of extending the touch screen in that way. This prior art, which was never presented to the Examiner, demonstrates that the ’311 patent’s claims reflect no more than a straightforward application of a known technique to devices disclosed in the prior art to achieve a predictable result.

In particular, challenged claims 1–20 of the ’311 patent are unpatentable as obvious over the combination of Kuriki (disclosing a capacitive touchscreen sensor with mesh electrodes) and Mikladal (teaching wrapping the electrodes of a capacitive touch sensor around the edges of a display), as explained in Grounds I–III below. These references are prior art under 35 U.S.C. § 102(e). And even if

Patent Owner were to prove entitlement to a priority date antedating these references, claims 1–20 would also be obvious over the combination of Moran (capacitive touchscreen sensor with mesh electrodes) and Joo (wrapping around the edges of a display), as explained in Grounds IV–VI below.

II. STANDING, MANDATORY NOTICES, AND FEE AUTHORIZATION

Grounds for Standing: Pursuant to 37 C.F.R. § 42.104(a), Petitioner certifies that the ’311 patent is available for IPR and that Petitioner is not barred or estopped from requesting an IPR challenging the ’311 patent on the grounds identified in this petition.

Real Party-in-Interest: Petitioner identifies Samsung Display Co., Ltd., Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. as real parties in interest.

Related Matters: Patent Owner has asserted the ’311 patent in litigation against the real parties-in-interest in *Solas OLED Ltd. v. Samsung Display Co., Ltd., et al.*, Case No. 2:19-cv-00152-JRG (E.D. Tex.).

Lead and Back-Up Counsel: Petitioner designates David A. Garr (Reg. No. 74,932, dgarr@cov.com) as lead counsel and Grant D. Johnson (Reg. No. 69,915, gjohnson@cov.com) as back-up counsel, both of Covington & Burling LLP, One CityCenter, 850 Tenth Street, NW, Washington, DC 20001 (postal and hand delivery), telephone: 202-662-6000, facsimile: 202-662-6291.

Petitioner also designates Peter P. Chen (Reg. No. 39,631) as back-up counsel, of Covington & Burling LLP, 3000 El Camino Real, 5 Palo Alto Square, 10th Floor, Palo Alto, CA 94306 (postal and hand delivery), telephone: 650-632-4700, facsimile: 650-632-4800.

Service Information: Service information is provided in the designation of counsel above. Petitioner consents to service of all documents via electronic mail at the email addresses above and at Samsung-Solas@cov.com.

Fee Authorization: The Office is authorized to charge $33,500 ($15,500 request fee and $18,000 post-institution fee) for the fees set forth in 37 C.F.R. § 42.15(a) (as well as any additional fees that might be due) to Deposit Account No. 60-3160.

III. SUMMARY OF CHALLENGE

Petitioner requests IPR of claims 1–20 of the ’311 patent under 35 U.S.C. § 103 based on the following prior art combinations:

- ***Ground I:*** Claims 1–13, 15, 16, and 18 are obvious over the combination of Kuriki and Mikladal.
- ***Ground II:*** Claims 14 and 17 are obvious over the combination of Kuriki, Mikladal, and Philipp.
- ***Ground III:*** Claims 19 and 20 are obvious over the combination of Kuriki, Mikladal, and Rappoport.

- ***Ground IV:*** Claims 1–13, 15, 16, and 18 are obvious over the combination of Moran and Joo.
- ***Ground V:*** Claims 14 and 17 are obvious over the combination of Moran, Joo, and Philipp.
- ***Ground VI:*** Claims 19 and 20 are obvious over the combination of Moran, Joo, and Rappoport.

The earliest claimed priority date of the '311 patent is October 28, 2011. Each of the asserted references is available as prior art under 35 U.S.C. § 102 (pre-AIA)[1], as shown in the following table.

Exhibit	Reference	Date(s)	Availability as Prior Art
Ex. 1003	U.S. Patent No. 8,722,314 ("Kuriki")	May 13, 2014 (issued); May 27, 2011 (filed)	§ 102 (e)
Ex. 1004	U.S. Patent No. 9,395,851 ("Mikladal")	July 19, 2016 (issued); September 5, 2012 (§ 371 filing date); March 7, 2011 (PCT filing date)	§ 102 (e)
Ex. 1005	U.S. Patent Application Pub. No. 2011/0102361 ("Philipp")	May 5, 2011 (published); October 29, 2009 (filed)	§§ 102 (a) and (e)

[1] Because the application for the '311 patent was filed prior to March 16, 2013, the pre-AIA conditions for patentability apply.

Exhibit	Reference	Date(s)	Availability as Prior Art
Ex. 1006	U.S. Patent Application Pub. No. 2012/0218219 ("Rappoport")	August 30, 2012 (published); February 28, 2011 (filed)	§ 102 (e)
Ex. 1007	International Publication No. WO 2010/099132 ("Moran")	September 2, 2010 (published)	§§ 102 (a), (b), and (e)
Ex. 1008	U.S. Patent Application Pub. No. 2008/0223708 ("Joo")	September 18, 2008 (published); August 28, 2007 (filed)	§§ 102 (a), (b), and (e)

IV. OVERVIEW OF THE '311 PATENT

The '311 patent (Ex. 1001) is entitled "Flexible Touch Sensor" and was filed on October 28, 2011. The '311 patent states that it "generally relates to touch sensors" for use in "touch screens," Ex. 1001, 1:5–23, and more specifically to *capacitive* touch sensors, *id.*, 1:27–33; Ex. 1023, ¶¶ 65–66.

The '311 patent explains that conventional capacitive touch sensors are made up of "capacitively coupled" "drive" and "sense" electrodes wherein a "voltage [is] applied to the drive electrode" which in turn "induce[s] a charge on the sense electrode" that is capacitively (but not electrically) coupled to that drive electrode. Ex. 1001, 3:31–64. "[T]he amount of charge induced [on the sense electrode] may be susceptible to external influence (such as a touch or the proximity of an object)." *Id.*, 3:39–43. Thus, by "measur[ing] the change in capacitance" between the drive and sense electrodes, a device can "determine the position of the touch or proximity

within the touch-sensitive area(s) of [the] touch sensor." *Id.*, 3:31–64; Ex. 1023, ¶ 67.

The '311 patent purports to improve on conventional sensors by using electrodes made from "metal-mesh" technology, Ex. 1001, 7:44–47, in which the electrode is composed of "fine lines of metal" intersecting to form a mesh pattern, *id.*, 5:56–6:13. The '311 patent explains that when such "metal-mesh" electrodes are formed on a "substantially flexible substrate," the resulting touch sensor can be wrapped around the edge of a device, *id.*, 7:37–8:2; Ex. 1023, ¶ 68.

The challenged claims are generally directed to an apparatus (or device) comprising a touch sensor disposed on a substantially flexible substrate. In particular, each independent claim requires:

i) "a substantially flexible substrate";

ii) "a touch sensor disposed on the substantially flexible substrate";

iii) that the "touch sensor" comprises "electrodes made of flexible conductive material configured to bend with the substantially flexible substrate";

iv) that the electrodes comprise "*<u>first and second conductive lines that</u>* electrically contact one another at an intersection to *<u>form a mesh grid</u>*"; and

v) that "the substantially flexible substrate and the touch sensor are configured to <u>*wrap around one or more edges of a display*</u>."

Ex. 1001, claims 1 and 7 (emphasis added).

Regarding the "mesh grid" requirements of limitation iv), mesh electrodes are described at 2:15–20 and 5:56–6:30 of the '311 patent. As shown in annotated Figure 2A below, the "mesh pattern" 20 of each electrode is "formed from . . . intersections between lines 22A with lines 22B of conductive material," Ex. 1001, 5:67–6:3; Ex. 1023, ¶ 68:

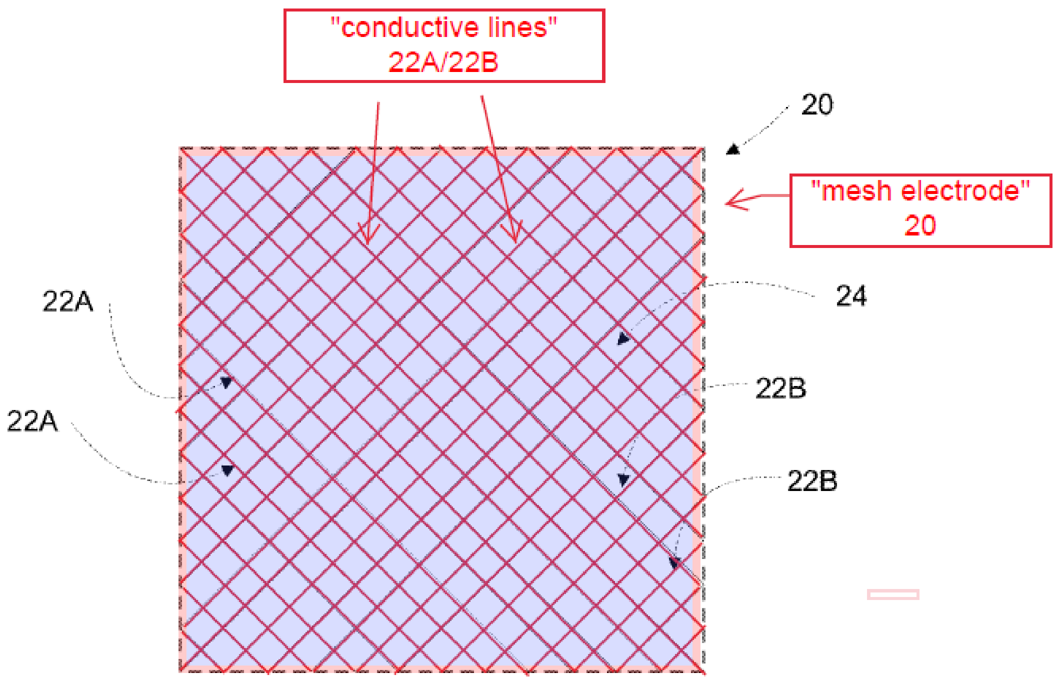


Figure 2A

As for the "wrap around" requirements of limitation v), the patent's only relevant discussion is located at 7:37–8:10 and Figure 7 of the disclosure. The '311

patent states that "touch-sensitive apparatus" 612 is "wrapped around" display 613, and that an "electrode pattern" made from "metal-mesh technology with a copper, silver, or other suitable metal mesh" is "disposed on a surface" of "substrate 602." Ex. 1001, 7:37–48. It also states that the "[s]ubstrate 602 and the conductive material of the electrode pattern may be flexible, enabling the conductive material to wrap around the left and right edges of the surface to left-side and right-side surfaces," *id.*, 7:48–51; Ex. 1023, ¶¶ 71–72, as illustrated in annotated Figure 7:

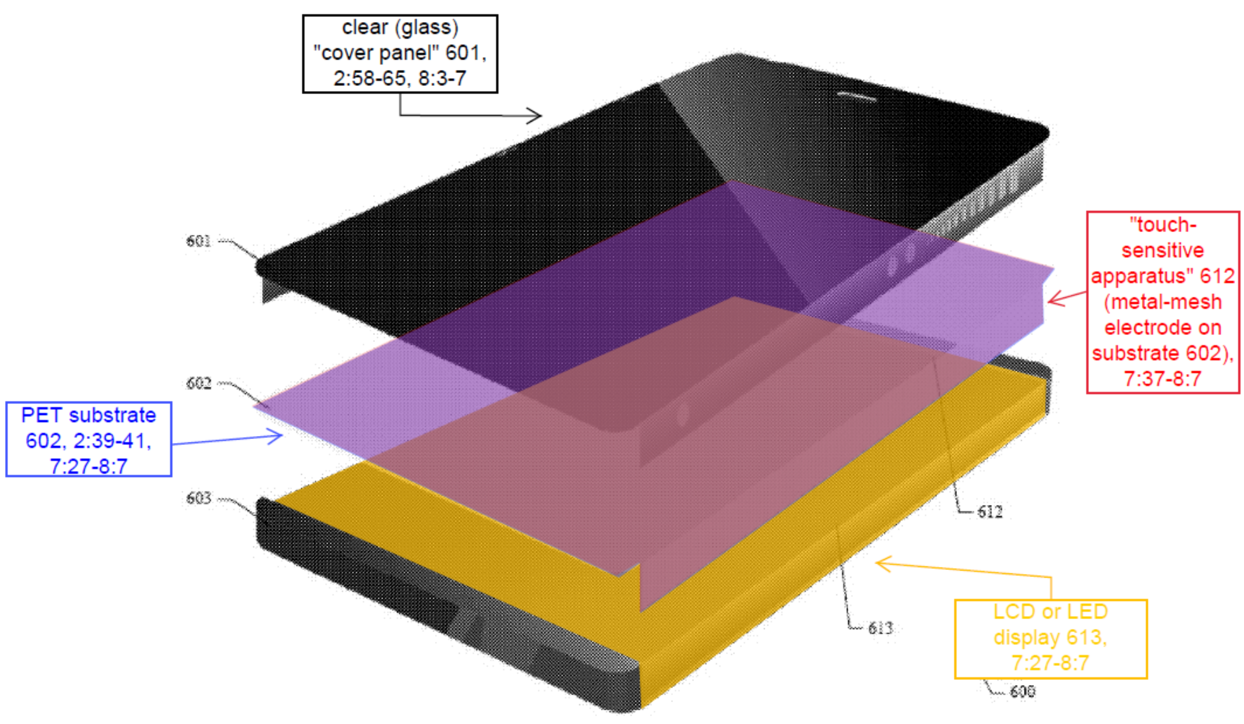


Figure 7

A. Prosecution History

The independent claims of the application that issued as the '311 patent originally contained only limitations i)–iii) listed above. Ex. 1002, 503–505. After

the Examiner rejected these claims as obvious, the applicants amended the claims over the next two years to add the "mesh grid" requirements of limitation iv)—namely: "wherein the flexible conductive material of the drive or sense electrodes comprises first and second conductive lines that electrically contact one another at an intersection to form a mesh grid." *Id.*, 218–229 (June 26, 2014 Amendment), 113–122 (March 3, 2015 Amendment).

Yet even after the addition of these "mesh grid" requirements, the Examiner continued to reject all of the pending claims as obvious over U.S. Patent Application Publication No. 2009/0219257 to Frey et al. ("Frey I"). The Examiner cited "the mesh bars from the touch screen sensor taught by [Frey I]," as disclosing the "mesh grid" requirements. *Id.*, 68–85 (March 19, 2015 Non-Final Rejection).

In response to the obviousness rejections over Frey I, the applicants further amended the claims to add the "wrap around" requirements of limitation v)—namely, "wherein . . . the substantially flexible substrate and the touch sensor are configured to wrap around one or more edges of a display." *Id.*, 54–64 (June 19, 2015 Amendment). The Examiner then allowed the claims in the next office action. *Id.*, 20–24 (September 24, 2015 Notice of Allowance).

V. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art of the '311 patent at the time of the alleged invention would have had a relevant technical degree in Electrical Engineering,

Computer Engineering, Computer Science, Materials Science, or the like, and 2–3 years of experience in touch sensor design. Ex. 1023, ¶¶ 77–78.

VI. CLAIM CONSTRUCTION

In IPR proceedings, claims are now construed "in accordance with their ordinary and customary meaning." 37 C.F.R. § 42.100(b); *see Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005). While Petitioner does not believe that any specialized constructions are necessary, for clarity Petitioner discusses the meaning of certain claim limitations below.

A. "to form a mesh grid"

The independent claims of the '311 patent specify that "the flexible conductive *material of the drive or sense electrodes* comprises first and second conductive lines that electrically contact one another at an intersection to form a mesh grid." Thus, the claims require that at least one electrode (either the drive or sense electrode) be in the form of a mesh grid.[2] This accords with the specification's

[2] That is, the claims do not contemplate a first conductive line from a first electrode that electrically contacts a second conductive line from a second electrode. Indeed, this would cause an electrical short and prevent the electrodes from functioning as a capacitive touch sensor. Ex. 1023, ¶ 81.

use of the term "mesh" to describe a single electrode composed of intersecting "fine lines of conductive material." Ex. 1001, 2:15–20, 5:56–6:30, Ex. 1023, ¶¶ 81–82.

B. "the substantially flexible substrate and the touch sensor are configured to wrap around one or more edges of a display"

This limitation raises two separate issues: the meanings of (1) "edges of a display"; and (2) "touch sensor . . . to wrap around [the] one or more edges." For purposes of determining whether to institute trial, however, neither of these issues need be resolved by the Board, as discussed below.

1. "edges of a display"

First, the '311 patent does not expressly define what it means to wrap around an "edge of a display." It describes "particular embodiments" in which a touch sensor "may wrap around *an edge 603 of example mobile phone 600*," and "other particular embodiments" in which the touch sensor is "wrapped around a *curved surface*." Ex. 1001, 7:55–60 (emphasis added). It further states that the sensor:

> may be wrapped over surfaces that are substantially perpendicular to each other or, if there is no substantial distinction between surfaces (such as, for example, a pebble-shaped or curved device), and angle of deviation between the surfaces of 45 degrees or greater.

Id., 7:61–65.

For this petition, however, the Board need not resolve whether an "edge of a display" must be an edge between "flat portions of surfaces" (such as "substantially perpendicular" surfaces) or if the claims may additionally encompass a sensor that

is "wrapped around a curved surface." As explained below, each prior art combination (Kuriki–Mikladal and Moran–Joo) discloses a touch sensor wrapped around an edge between substantially perpendicular surfaces of a display, and therefore teaches this limitation under any of these interpretations.

2. "touch sensor . . . to wrap around [the] one or more edges"

Second, while the claims require the "touch sensor" to wrap around a display edge, they do not specify *which portion* of the sensor that is to be so "wrapped." And the "touch sensor 10" of the '311 patent may include not only touch-sensitive electrodes, *see* Ex. 1001, 3:31–4:36, but also "tracks 14" and "ground lines" that couple the electrodes to bond pads (for connection to outside circuitry), *see id.*, 5:15–44, 5:19–21 ("Tracks 14 may extend into or around . . . the *touch sensitive area(s)* of touch sensor 10.") (emphasis added), Fig. 1. Claims 2 and 8 of the '311 patent also support this understanding, expressly requiring that "the touch sensor further comprises tracking . . . to provide drive or sense connections." Thus, the claimed "touch sensor" may encompass tracks ("tracking") in addition to electrodes.

Further, the claims' recitation of a "touch sensor . . . configured to wrap around one or more edges of a display" does not expressly require that the *touch-sensitive portion* of the touch sensor be configured for wrapping around a display edge. However, for this petition, the Board need not resolve whether these claims require the *touch-sensitive* portion of the touch sensor to wrap around one or more

edges of a display (as opposed to, more broadly, a device (or apparatus) in which a different portion of the touch sensor (i.e., the tracking) is configured for wrapping around a display edge), because the prior art teaches or suggests wrapping touch-sensitive portions of a touch sensor around the edges of a display, as explained below.

VII. OVERVIEW OF THE PRIOR ART

As discussed above, the ’311 patent’s claims are directed to flexible capacitive touch sensors with two main features: (1) “mesh” electrodes and (2) wrapping the touch sensor around an edge of a display. Both were well known in the art.

Regarding the first feature, it is clear from the prosecution history that capacitive touch sensors using mesh electrodes were not novel. For example, as the Examiner explained, Frey I (one of several 3M prior art patent applications directed to this technology) described a capacitive touch sensor with “two dimensional[] mesh” electrodes made up of the same materials (PET substrate and metal electrodes) as those described and claimed by the ’311 patent, Ex. 1013, ¶¶ [0057]–[0061], [0074]–[0077], [0080]; *see also* Ex. 1023, ¶¶ 53–54, 97, 100–103 (citing Exs. 1005, 1007, 1013, 1014).

Similarly, the assignee and inventors of the ’311 patent had themselves authored several prior art references teaching the use of mesh electrodes in capacitive touch screens (though these were not disclosed to the Examiner during prosecution). For example, U.S. Patent Application Publication No. US

2010/0045632 (Ex. 1010), which has the same lead inventor (Esat Yilmaz) and assignee (Atmel Corp.) as the ’311 patent, was published a year and a half before the ’311 patent was filed (and is thus prior art under Section 102(b)), and described “capacitive touch sensor[s]” in which “each drive and/or sense electrode is made of a mesh or filigree pattern of interconnected lines of highly conductive material” that is “practically invisible,” Ex. 1010, ¶¶ [0021]–[0022], those mesh electrodes being formed of metal on a PET substrate, *id.*, ¶ [0120]. *See also* Ex. 1023, ¶¶ 49–52 (citing Exs. 1010, 1011, 1012).

Other references similarly disclosed capacitive touch sensors made up of mesh electrodes. Ex. 1023, ¶¶ 45–48, 55 (citing Exs. 1020, 1022). These include U.S. Patent No. 8,722,314 (“Kuriki”) and International Publication No. WO 2010/099132 (“Moran”), as discussed below and relied on as primary references for Grounds I–III and IV–VI (respectively).

As for the second feature—wrapping a flexible capacitive touch sensor around an edge of a display—this too was a well-known technique, as confirmed by prior art that was *not* before the Examiner. In particular, U.S. Patent No. 9,395,851 (“Mikladal”) and U.S. Patent Application Pub. No. 2008/0223708 (“Joo”), as discussed below and relied on in Grounds I–III and IV–VI (respectively), disclosed wrapping a flexible touch sensor around edges of a device’s display in order to form

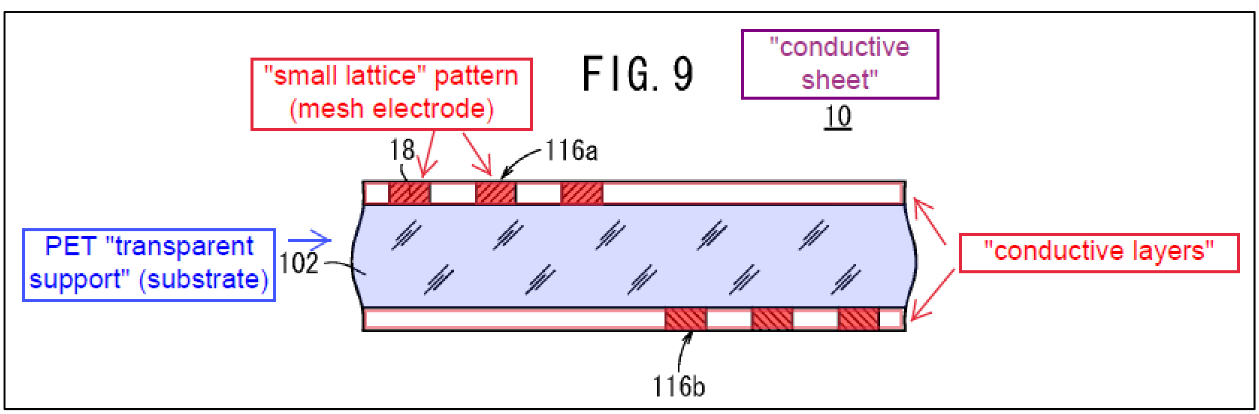
touch-sensitive regions on the sides of that device. *See also* Ex. 1023, ¶¶ 60–64, 93–96, 104–106 (citing Exs. 1004, 1008, 1015, 1016, 1021).

A. Kuriki (Ex. 1003)

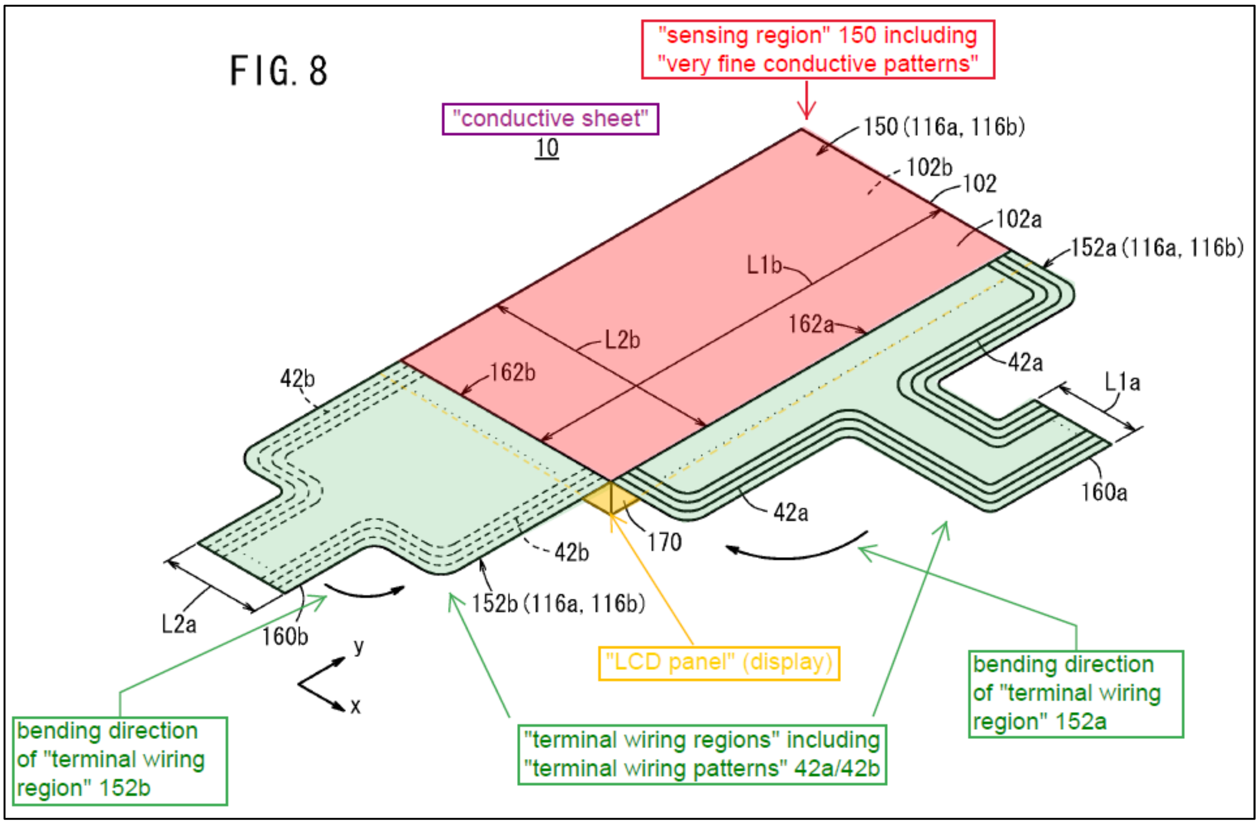
Kuriki is a U.S. Patent filed on May 27, 2011, which is prior art under 35 U.S.C. § 102(e). Kuriki was not cited or considered during prosecution.

Like the '311 patent, Kuriki is directed to capacitive touch panels. Kuriki discloses "conductive sheet[s] . . . for use in a projected capacitive touch panel," Ex. 1003, 1:17–20, and approaches for "forming an electrode for a touch panel" in that conductive sheet, *id.*, 2:37–50; Ex. 1023, ¶ 83. As discussed further below, Kuriki's electrodes are formed using patterns of square "small lattices 18"—i.e., mesh electrodes. Ex. 1003, 12:9–25; Ex. 1023, ¶ 83.

As shown in annotated Figure 9 below, Kuriki's "conductive sheet 10" is a layered structure, in which silver "conductive layers" (116a/116b) are formed into "small lattice 18" patterns on either side of a PET substrate ("transparent support 102"). Ex. 1003, 11:64–12:25; Ex. 1023, ¶ 84:



As illustrated in Figure 8, the conductive sheet 10 includes a "sensing region 150," which "has very fine conductive patterns" and is used for capacitive sensing. Ex. 1003, 11:64–12:25. The sheet also features "terminal wiring region[s]" (152a/152b), which include "terminal wiring patterns" used to connect the sensing region "to an IC circuit for position calculation or the like," *id.*, 18:35–53; Ex. 1023, ¶ 85:



As shown in annotated Figures 10 and 11 below, the conductive patterns of the sensing region are essentially in the shape of a checkerboard of connected mesh electrodes, which are disposed on the PET substrate. Ex. 1003, 12:9–46; Ex. 1023, ¶¶ 86–87, 90–91. The squares that make up the checkerboard are described by

Kuriki as "conductive large lattices 16A," Ex. 1003, 12:10–13, and the checkerboard formation is described as "conductive pattern 26A," *id.*, 12:40–46. These "large lattice" squares "each contain a combination of two or more small lattices 18." *Id.*, 12:13–15. These small lattices may have a "smallest square shape," *id.* at 12:24–25, and therefore form a mesh, Ex. 1023, ¶¶ 86–87, 90–91. As Kuriki explains, when the "side length of each small lattice" (the length of each square in the mesh) is within a preferred range of "50 to 500 µm, more preferably 150 to 300 µm . . . , the conductive sheet has *high transparency* and thereby can be suitably used at the front of a display device with *excellent visibility*." Ex. 1003, 12:34–39 (emphasis added):

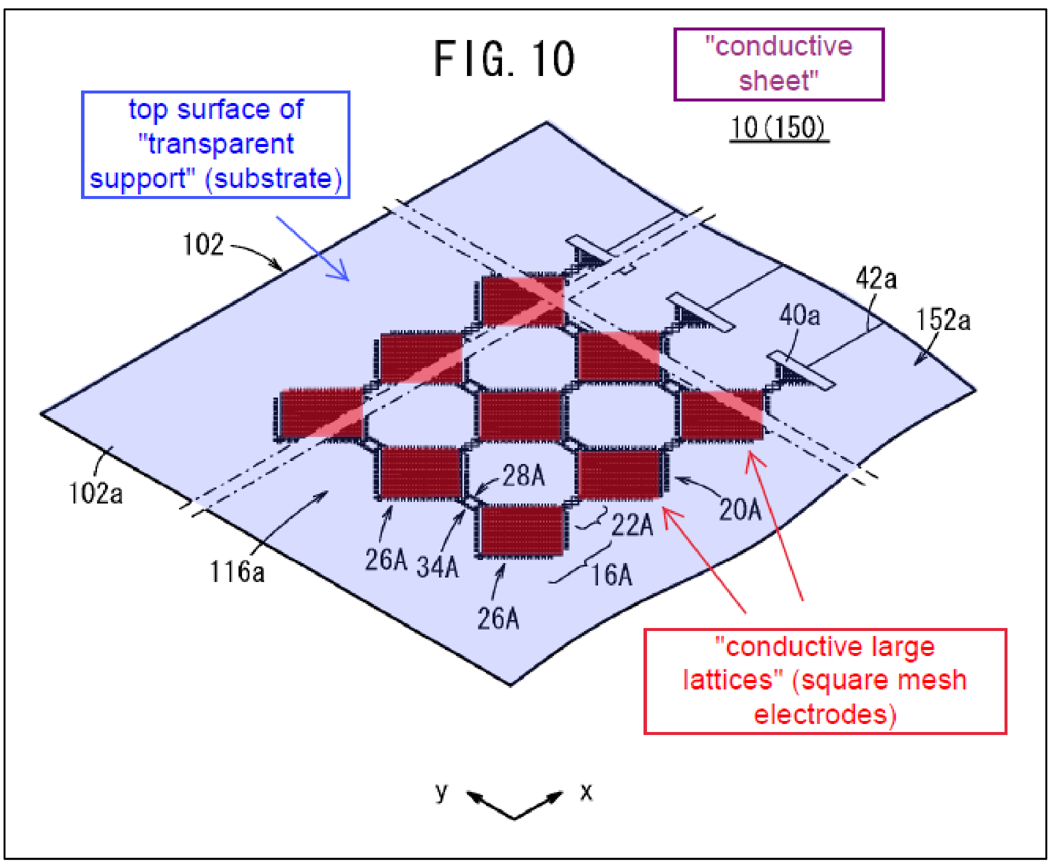
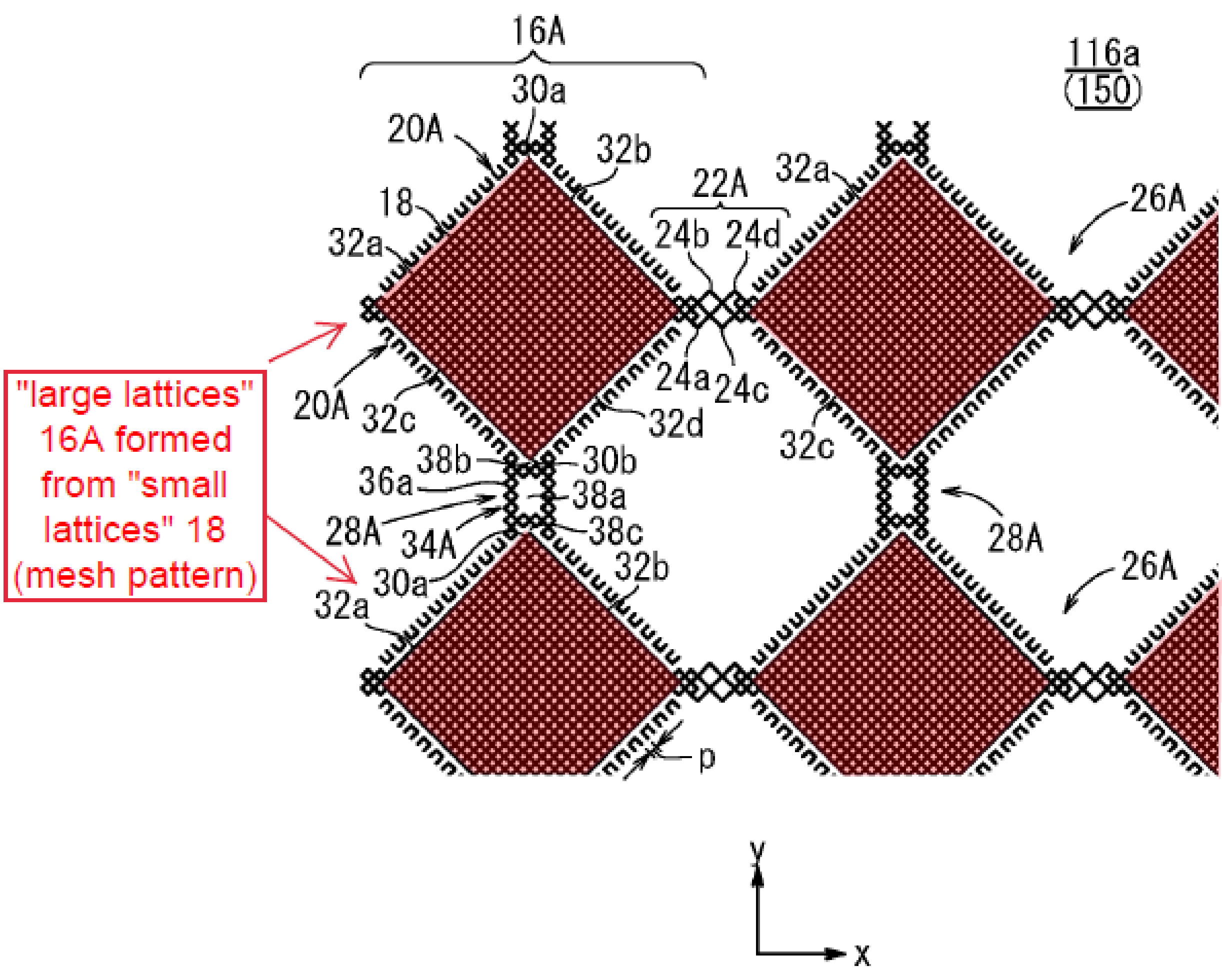


FIG. 11



The above Figures 10 and 11 illustrate the top or "upper" surface 102a of the conductive sheet 10, and the patterns formed in the conductive layer 116a layered on that top surface. Ex. 1003, 12:9–13. The bottom surface 102b of the conductive sheet features similar, complementary patterns, which are formed in conductive layer 116b, and which are illustrated in Figures 12 and 13 of Kuriki. *Id.*, 12:47–13:3.

Again, these include generally square-like[3] "conductive large lattices 16B," patterned into a checkerboard ("conductive pattern 26B"), where the large lattices "each contain a combination of two or more small lattices." *Id.*, 12:47–51, 12:64–13:1; Ex. 1023, ¶¶ 86–87, 90–91.

"When a finger comes into contact" with Kuriki's touchscreen, "signals are transmitted from the first conductive pattern 26A and the second conductive pattern 26B corresponding to the finger touch position to the IC circuit. The finger touch position is calculated in the IC circuit based on the transmitted signals." Ex. 1003, 18:46–53; Ex. 1023, ¶ 87.

Kuriki further teaches attaching its capacitive sensor to a display. First, Kuriki's "conductive sheet 10" "is placed on a liquid crystal display panel 170," as shown in annotated Figure 8 below, Ex. 1003, 21:3–7; Ex. 1023, ¶ 92. Then, the "terminal wiring region[s]" (152a and 152b) of the conductive sheet (which connect the sensing region 150 to the controller circuitry) are "bent toward the back side of the sensing region 150 (i.e. the back side of the liquid crystal display panel 170)," as illustrated by annotated Figure 18 below. Ex. 1003, 21:8–12, Fig. 15 at S106. In

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[3] Technically, the "conductive large lattices 16B" in Figures 12 and 13 of Kuriki are "approximately octagonal" in shape, with four long sides and four short sides. Ex. 1003, 14:65–15:4.

other words, the terminal wiring regions are wrapped around the edges of the display panel, Ex. 1023, ¶ 93:

FIG. 8

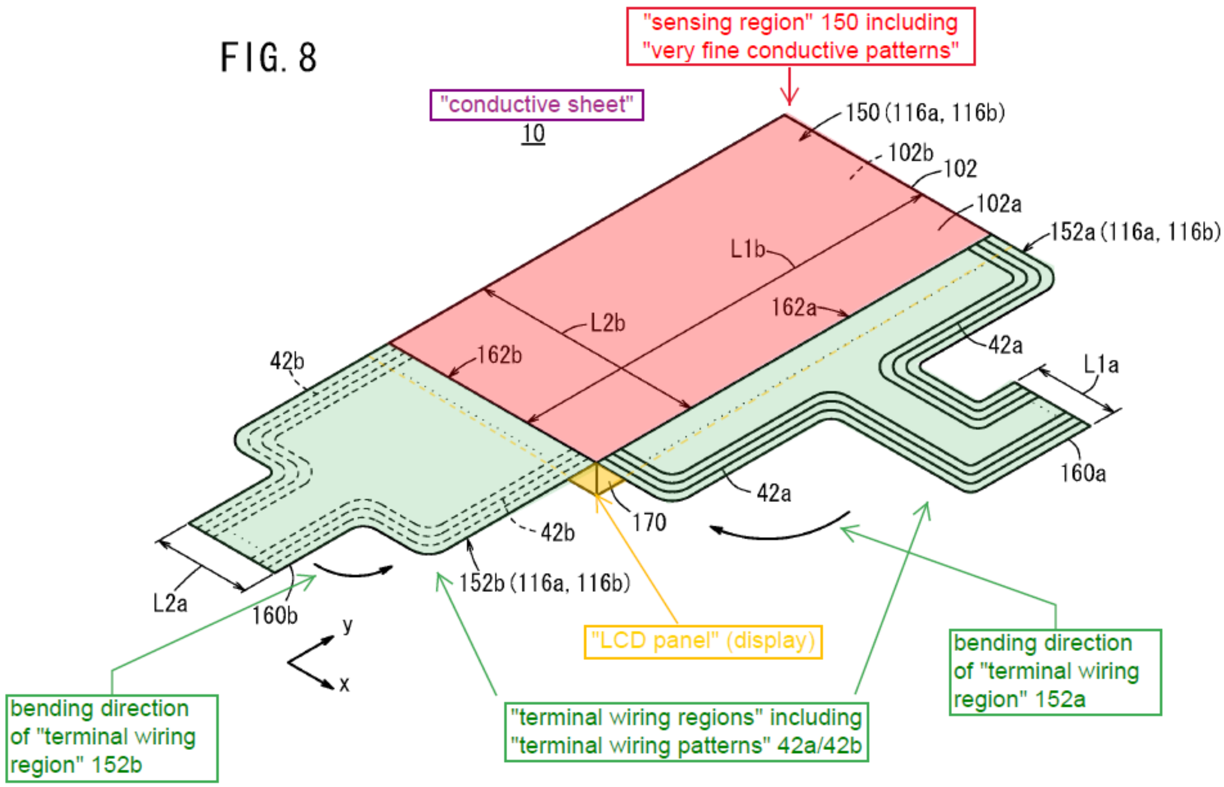
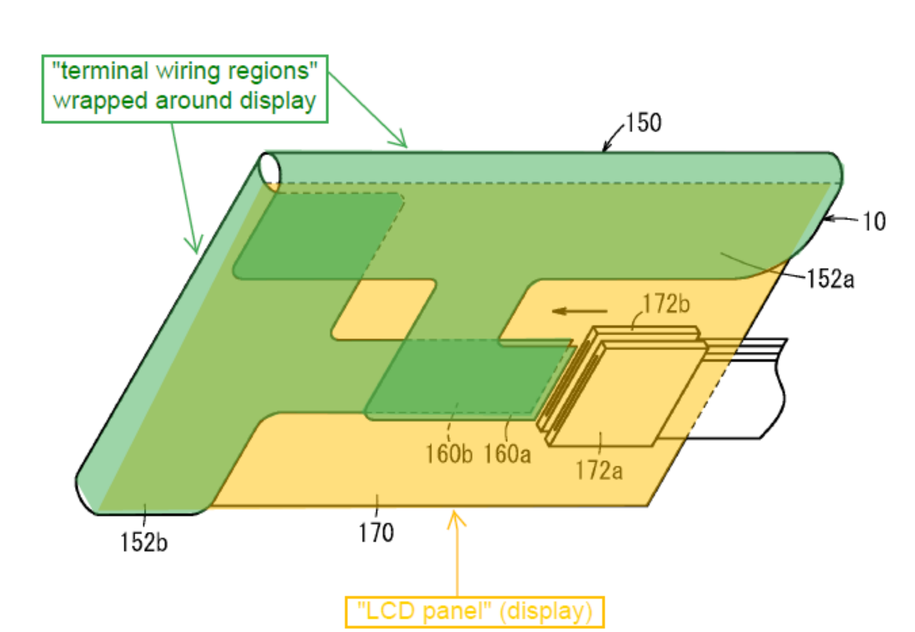


FIG. 18



B. Mikladal (Ex. 1004)

Mikladal is a U.S. Patent that was filed on Sept. 5, 2012. Mikladal claims priority to PCT Application No. PCT/FI2011/050197, which was filed in English on March 7, 2011, designating the United States, and was published on September 9, 2011 in English as WO 2011/107666. *Id.*; Ex. 1009. Mikladal is thus prior art under 35 U.S.C. § 102(e). Mikladal was not cited or considered during prosecution.

Like the '311 patent (and Kuriki), Mikladal is also directed to capacitive touch sensors—and more specifically, a "capacitive touch sensitive film" that "can be used as a touch sensitive element in a touch sensing device." Ex. 1004, 3:37–4:11. Mikladal explains that its "touch sensitive film is formed as a flexible structure so as to allow bending thereof along a three dimensional surface," such as around the edges of a device. *Id.*, 7:19–26. Such a flexible touch sensor is illustrated by Figure 3 of Mikladal, which depicts "a mobile electronic device 6 having a touch screen 7 comprising a touch sensitive film 1 according to Figure 1 bent or deformed along the curved side surface of the device having a radius of curvature r=4mm," *id.*, 14:1–5; Ex. 1023, ¶¶ 94–95:

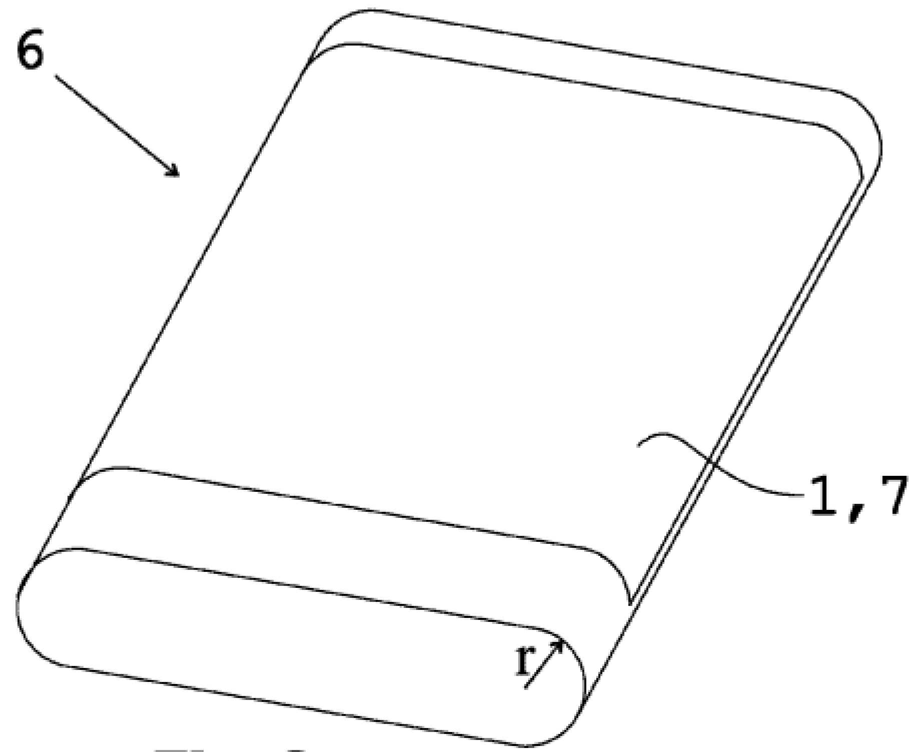


Fig. 3

Also like the ’311 patent (and Kuriki), Mikladal discloses that its capacitive touch sensor is made up of a metal “conductive layer 3” (Ex. 1004, 12:10–11, 6:43–63 (“conductive layer comprises . . . metal nanowires”)) layered on a PET “substrate 2” (*id.*, 12:10–25 (“substrate can be made of, for example, polyethylene terephthalate PET”), and placed “on a display as a part of a touch screen,” *id.*, 12:26–35; Ex. 1023, ¶ 96.

Mikladal stresses that the flexibility of its capacitive touch sensor allows for significant advantages:

> Flexibility and/or deformability of the touch sensitive film in combination with the unique sensitivity performance thereof ***opens entirely novel possibilities to implement touch sensing devices***. For

> example, a touch sensitive film serving as the user interface of a mobile device ***can be bent or formed to extend to the device edges*** so that the touch sensitive film can cover even the entire surface of the device. In a touch sensitive film covering different surfaces of a three-dimensional device, ***there can be several touch sensing regions for different purposes***. One sensing region can cover the area of a display to form a touch screen. ***Other sensing regions e.g. at the sides of the device can be configured to serve as touch sensitive element replacing the conventional mechanical buttons, e.g. the power button.***

Ex. 1004, 7:31–44 (emphasis added); Ex. 1023, ¶ 94.

C. Philipp (Ex. 1005)

Philipp is a U.S. Patent Application Publication filed on October 29, 2009 and published on May 5, 2011, and thus is prior art under 35 U.S.C. §§ 102(a) and (e). Philipp was not cited or considered during prosecution.

Philipp is directed to capacitive touch sensors for display that use mesh electrodes to determine the location of a touch on the touchscreen. Ex. 1005, abstract, ¶¶ [0006], [0018], [0041]–[0042]. Specifically, Philipp teaches the use of mesh electrodes in which the conductive lines that make up the mesh electrode are "*wavy lines . . . formed of a series of curves*," as depicted in Figure 4 of Philipp. *Id.*, ¶¶ [0041]–[0045] (emphasis added). As Philipp explains, the use of wavy lines helps to "avoid creating moiré patterns when overlaying a display," *id.*; Ex. 1023, ¶ 97:

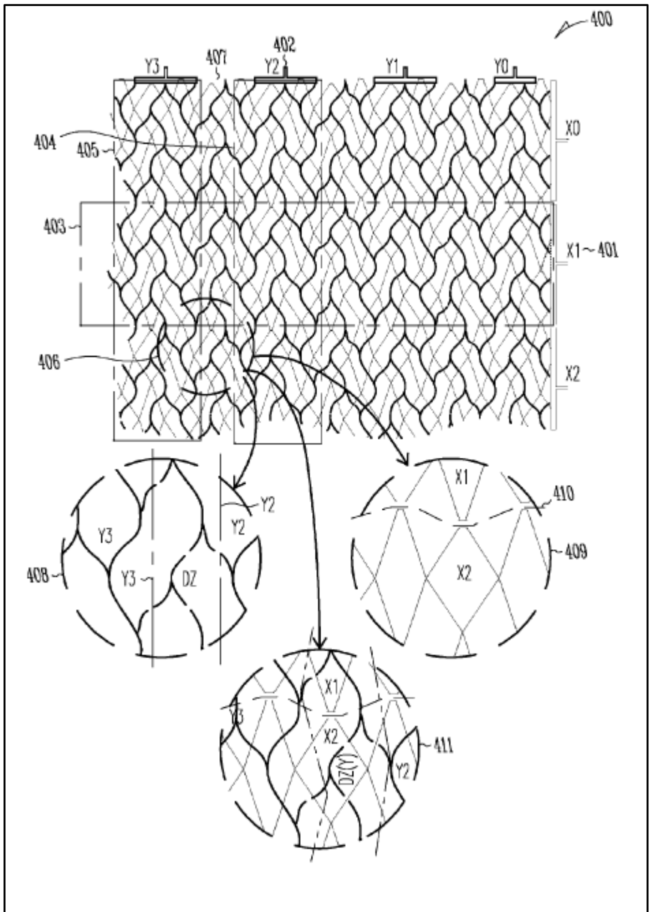


Fig. 4

D. Rappoport (Ex. 1006)

Rappoport is a U.S. Patent Application Publication filed on February 28, 2011, which is prior art under 35 U.S.C. § 102(e). Rappoport was not cited or considered during prosecution.

Rappoport is directed to devices featuring capacitive touch screen sensor overlaying a display. Ex. 1006, ¶¶ [0029], [0049]. Rappoport teaches that at the edges of the device, "conductive traces . . . such as control lines 62" that are "formed on the surface of [a] substrate 60" are "enlarged (e.g. widened and/or thickened) in

the vicinity of bend axis 56," along which axis the conductive lines are bent around the edge of the device, as illustrated by Figures 7–9 of Rappoport below. *Id.*, ¶¶ [0038]–[0043]. As Rappoport explains, such widened/thickened lines are advantageous to "help ensure that traces 62 are not cracked or otherwise damaged" when bent around the edge, *id.*, ¶ [0043]; Ex. 1023, ¶¶ 98–99:

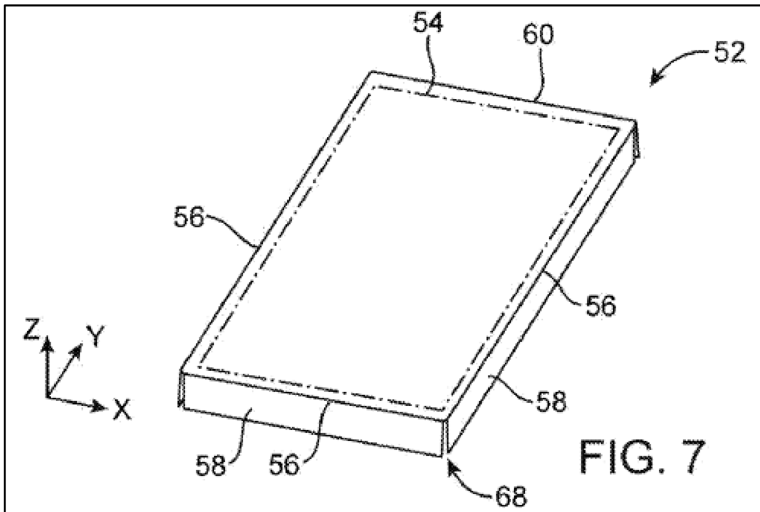


FIG. 7

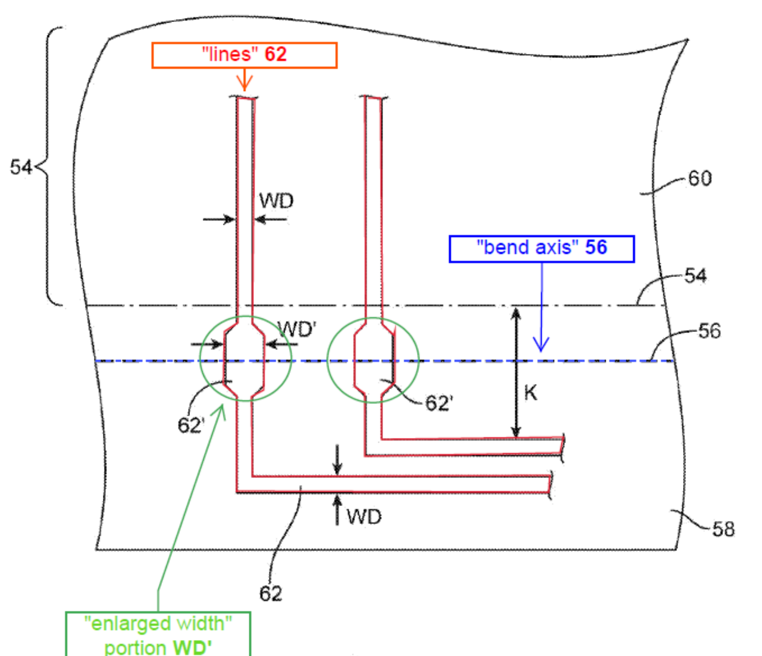


FIG. 8

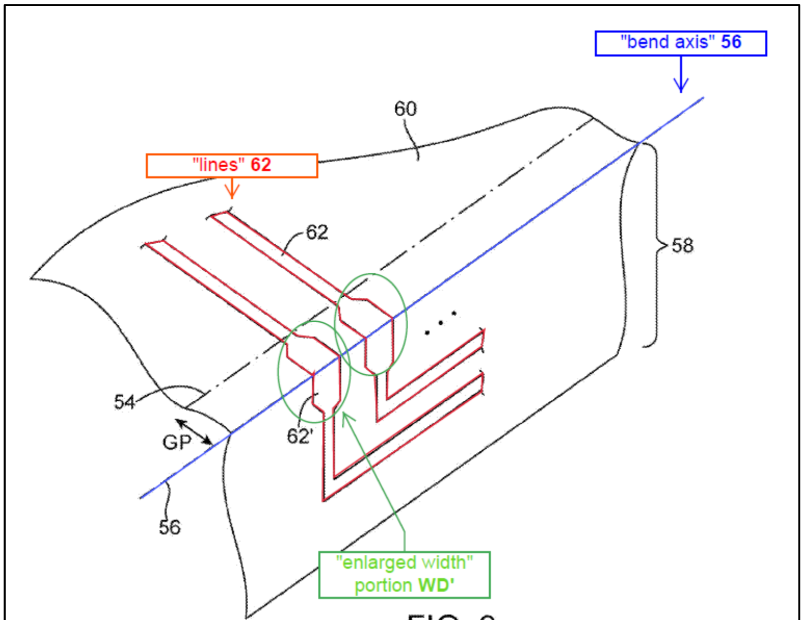


FIG. 9

E. Moran (Ex. 1007)

Moran is an International Publication of a PCT application that was filed on February 24, 2010, designating the United States, and published in English on September 2, 2010, and thus is prior art under 35 U.S.C. §§ 102(a), (b), and (e).

Moran was not cited or considered during prosecution. Moran shares much of the substantive disclosure of the Frey I patent that was applied during prosecution, and found to disclose the "mesh grid" claim requirement, Ex. 1002 at 68–85 (March 19, 2015 Non-Final Rejection)). Like Frey I, Moran lists Matthew H. Frey as an inventor and 3M as an assignee. Unlike Frey I, however, Moran further expressly discloses that both the drive and sense electrodes (which Moran refers to as "micropatterns") are disposed on the same surface of the substantially flexible substrate. Ex. 1007, 8:29–9:5 ("[t]he second conductive micropattern may be

disposed on the same substrate as the first conductive micropattern”), 6:7–26 (stating that both conductive micropatterns are “patterned onto the surface of the substrate in a mesh geometry . . . provided that the second conductive micropattern . . . is electrically isolated from the first conductive micropattern”). Ex. 1023, ¶ 100.

Moran is generally directed to “capacitive touch screen sensors that are integrated with electronic displays.” Ex. 1007, 7:4–9, 6:7–26. Specifically, Moran’s “touch screen sensors” are “micropatterned substrates that comprise a visible light transparent substrate and at least two electrically conductive micropatterns disposed on or in the visible light transparent substrate.” *Id.*, 4:18–26. These sensors are “overla[id]” onto “a viewable portion of the information display” screen, *id.*, 6:30–7:3, and connected to circuitry that “driv[es] the conductive micropatterns with electrical signals for the purpose of capacitively detecting the presence or location of a touch event to an information display,” *id.*, 6:7–26; Ex. 1023, ¶¶ 100–101.

Moran discloses that “[p]referred conductive micropatterns include regions with two dimensional meshes (or simply, meshes), where a plurality of linear micropattern features (often referred to as conductor traces or metal traces) such as micropatterned lines define enclosed open areas within the mesh,” as illustrated by Figure 2 of Moran, Ex. 1007, 9:17–22, Ex. 1023, ¶ 101:

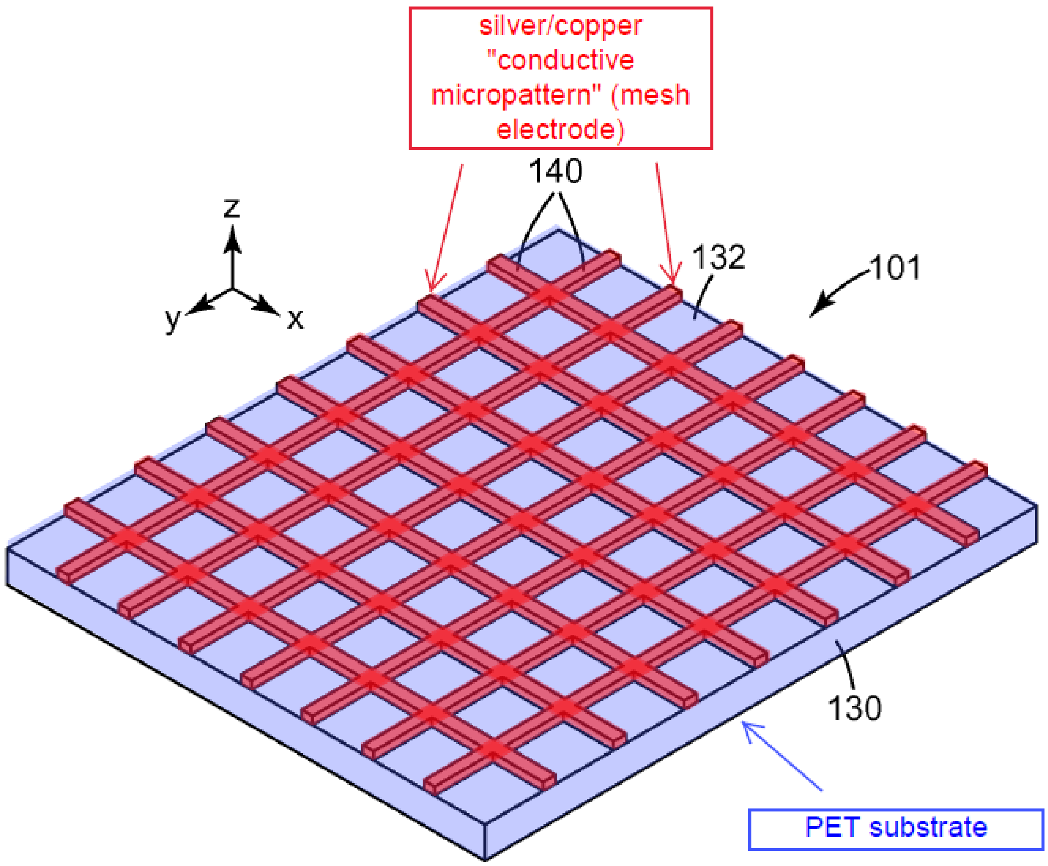


Fig. 2

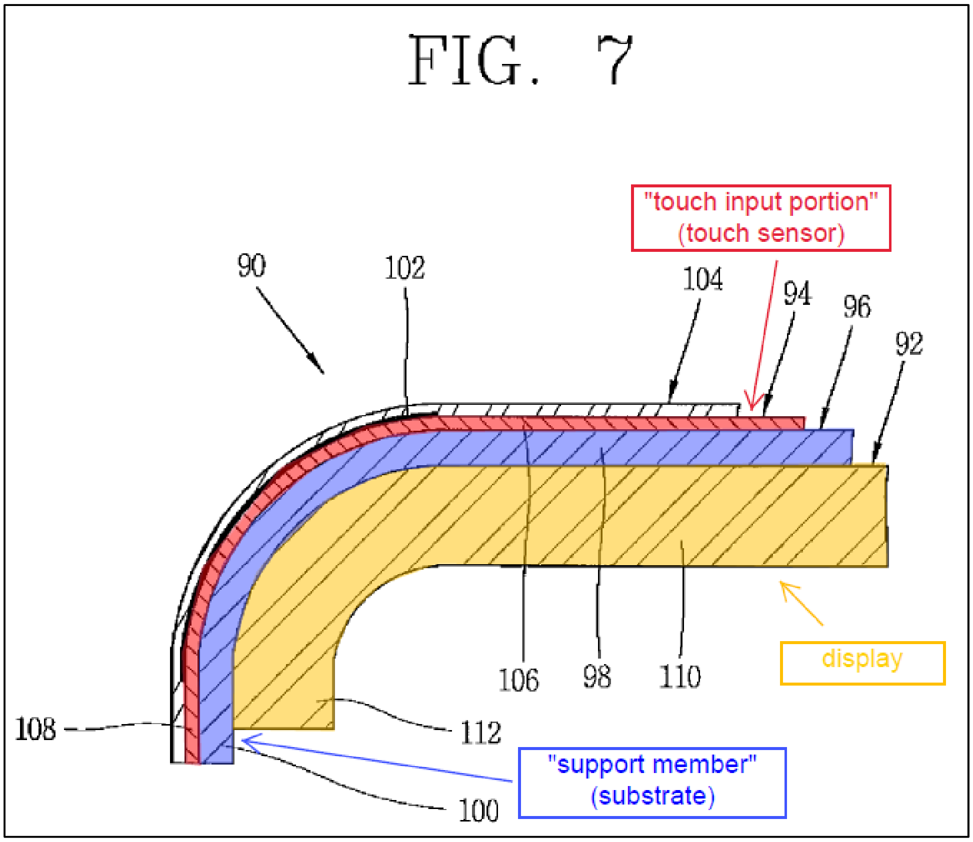
Moran discloses that "useful polymers for light transparent substrate 130 include polyethylene terephthalate (PET)," Ex. 1007, 7:16–26, and that "electrically conductive micropattern 140 can be formed of a plurality of linear metallic features," *id.*, 7:25–26, using metals such as silver or copper, *id.*, 22:13–15. Moran explains that conductive lines occupy only a small percentage of the micropatterned area (preferably, between 5% and 0.05%), *id.*, 11:19–12:6, and that its micropatterns allow the sensor to be "*visible light transparent*" such that "information (e.g., text, images, or figures) that is rendered by the [underlying] display can be *viewed*

through the touch sensor," *id.*, 8:13–21 (emphasis added). Moran discloses that the PET substrate and conductive metal micropattern disposed thereon are "substantially planar and flexible." *Id.*, 8:15–16, 5:17–19; Ex. 1023, ¶¶ 102–103.

F. Joo (Ex. 1008)

Joo is a U.S. Patent Application Publication that was filed on August 28, 2007 and published on September 18, 2008, and thus is prior art under 35 U.S.C. §§ 102(a), (b), and (e). Joo was not cited or considered during prosecution.

Joo is directed to a transparent "touch sensitive"/"touch input portion" of a mobile device that overlays a display. Ex. 1008, ¶ [0037]. Joo discloses that "touch input portion 94" is molded on a surface of "support member" 96, that both the touch input portion and the support member on which it is molded overlay "display unit 92," *id.*, ¶¶ [0060]–[0063], and that the support member is "formed of a transparent material, such as a polycarbonate material," *id.*, ¶¶ [0061], [0042], [0053]. This "touch input portion 94" is illustrated by Figure 7 of Joo. *Id.*, ¶ [0061], Ex. 1023, ¶¶ 104–105:



As shown in annotated figure 7, Joo discloses that its "display unit 92 is *bent at the edge of the upper display portion 110 in the form of a curved surface*, thereby forming a side display portion 112." Ex. 1008, ¶ [0063] (emphasis added). As Joo explains, this provides a significant advantage: because "the touch input portion for generating input when being touched is extendingly formed at the side surface portion of the cover as well as the upper surface portion thereof . . . a separate side key is not required to be mounted at the side surface of the terminal for generating input, thereby simplifying the manufacturing process thus to reduce the manufacturing cost and make the enhanced appearance of the terminal." *Id.*, ¶ [0067]; Ex. 1023, ¶ 106.

VIII. APPLICATION OF PRIOR ART TO THE CHALLENGED CLAIMS

The framework for the analysis for determining obviousness is set forth in the well-known factors outlined in *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1996), and the Petition analyzes these *Graham* factors below. Grounds I–III detail how claims 1–20 of the '311 patent were obvious based on the combination of Kuriki and Mikladal, and Grounds IV–VI detail how claims 1–20 were obvious based on the combination of Moran and Joo. None of the prior art references or arguments in Grounds I–VI were considered by the Examiner. The Wolfe Declaration (Ex. 1023) was also not before the Examiner. Accordingly, none of the arguments raised in this Petition were previously presented to the USPTO. 35 U.S.C. § 325(d).

Further, the Grounds below are not duplicative of one another. Grounds I–III involve primary references that are prior art under Section 102(e) (Kuriki and Mikladal). To the extent that Patent Owner is able to antedate either of these references, Grounds IV–VI would nevertheless remain applicable, as they involve primary references that are prior art under Section 102(b) (Moran and Joo).

A. Ground I: Claims 1–13, 15–16, and 18 Are Unpatentable Under 35 U.S.C. § 103 Over the Combination of Kuriki and Mikladal.

Claims 1–13, 15–16, and 18 are obvious over the combination of Kuriki and Mikladal. Like the '311 patent, Kuriki discloses a capacitive touch panel for a touchscreen, the "sensing region" of that touch panel's "conductive sheet" composed of silver mesh electrodes formed on both surfaces of a flexible PET substrate, and

wrapping that flexible conductive sheet around the edges of an LCD display. Mikladal discloses wrapping a flexible capacitive touch sensor around the edges of a device's display in order to form touch-sensitive display portions on the sides of the device. As explained further below, it would have been obvious for a POSA to use Mikladal's teaching to improve Kuriki's touchscreen device, and thus satisfy the above-listed claims. Ex. 1023, ¶¶ 107–108.

Because neither Kuriki nor Mikladal was before the Examiner, this Petition does not raise the same or substantially the same prior art or arguments previously considered by the Examiner. 35 U.S.C. § 325(d). In particular, Mikladal discloses the claim limitation that the Examiner believed was missing from the prior art and that resulted in the allowance of the '311 patent: a "touch sensor [] configured to wrap around one or more edges of a display." Ex. 1002 at 20–24 (September 24, 2015 Reasons for Allowance).

1. Claims 1 and 7

1[preamble]/7[preamble]: "An [apparatus/device] comprising:"

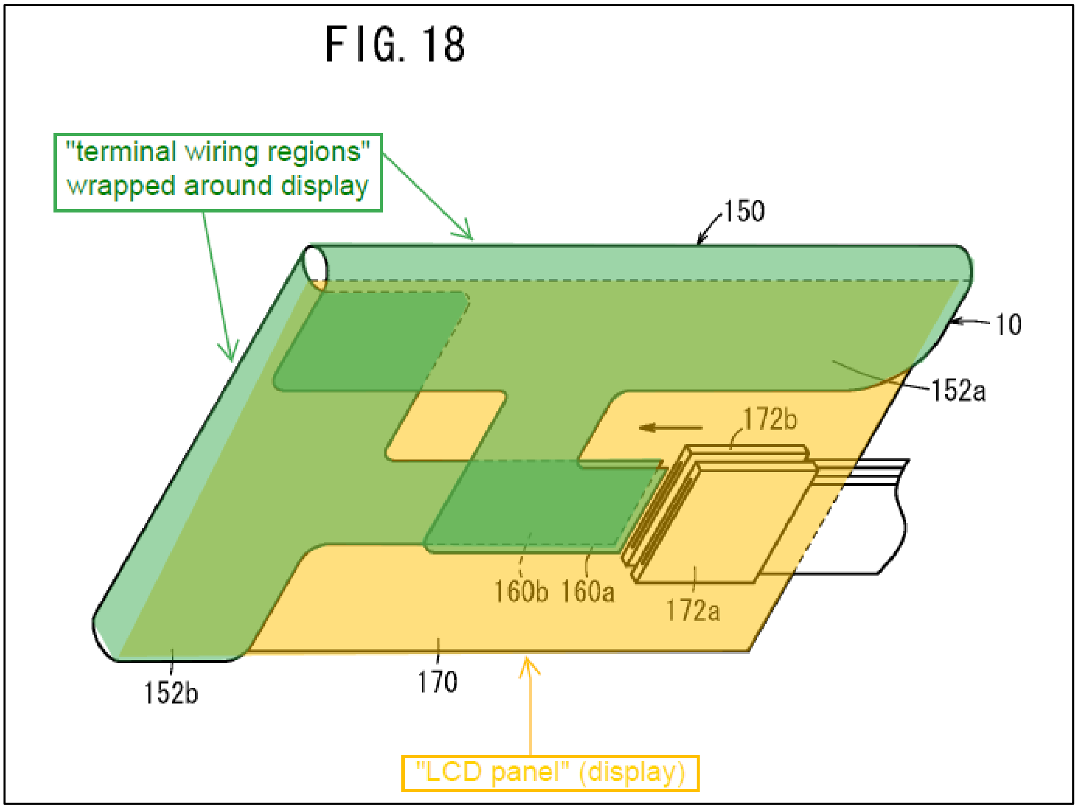
To the extent the preamble is limiting, it is disclosed by Kuriki. Kuriki discloses a "conductive sheet 10 [that] is placed on a liquid crystal display panel 170," then wrapped around that liquid crystal display panel and "electrically connected to an IC circuit for position calculation, etc." to produce a "touch panel," Ex. 1003, 21:3–17, whereupon "finger touch position is calculated in the IC circuit

based on the transmitted signals" from the capacitive touch sensor, *id.*, 18:46–53; Ex. 1023, ¶¶ 109–110.

1[a]/7[a]: "a substantially flexible substrate"

Kuriki discloses using a substantially flexible substrate, "transparent support 102," as the base of the "conductive sheet 10 used in the touch panel." Ex. 1003, 11:57–12:3. Kuriki discloses that the "particularly preferred" material for "transparent support 102" is "polyethylene terephthalates (PET)," because of its "light transmittance" and "workability." *Id.*, 23:3–23. Indeed, the '311 patent discloses PET as a "suitable material" for its substrate. Ex. 1001, 2:38–40; Ex. 1023, ¶ 111.

Kuriki further discloses that its conductive sheet 10 can be "bent toward the back side of the sensing region 150 (i.e. the back side of the liquid crystal display panel 170)" and thus wrapped around the edges of liquid crystal display panel 170, as depicted in Figure 18 of Kuriki (below). Ex. 1003, 21:8–12, Fig. 15 at S106; Ex. 1023, ¶¶ 112–113. Accordingly, a POSA would understand that Kuriki's substrate ("transparent support" 102) is substantially flexible. *Id.*:



1[b]/7[b]: "a touch sensor disposed on the substantially flexible substrate"

Kuriki discloses a touch sensor disposed on the substantially flexible substrate. Specifically, Kuriki discloses that its "conductive sheet 10" is to be "used in the touch panel," and that it comprises a "sensing region 150" made up of "very fine conductive patterns" that are "formed on" each "main surface" (upper surface 102a and lower surface 102b) of the "transparent support 102" (substrate). Ex. 1003, 11:57–12:25; Ex. 1023, ¶ 114. This "sensing region" includes checkerboard-like conductive patterns (26A/26B) which are used to determine a "finger touch position." Ex. 1003 at 18:35–53, Ex. 1023, ¶ 114. A POSA would have recognized, therefore,

that the conductive patterns formed on the surfaces of the transparent support (including the checkerboard-like patterns 26A/26B) satisfy this claim limitation. *Id.*

1[c]/7[c]: "the touch sensor comprising [drive or sense electrodes/a plurality of capacitive nodes formed from drive or sense electrodes] made of flexible conductive material configured to bend with the substantially flexible substrate"

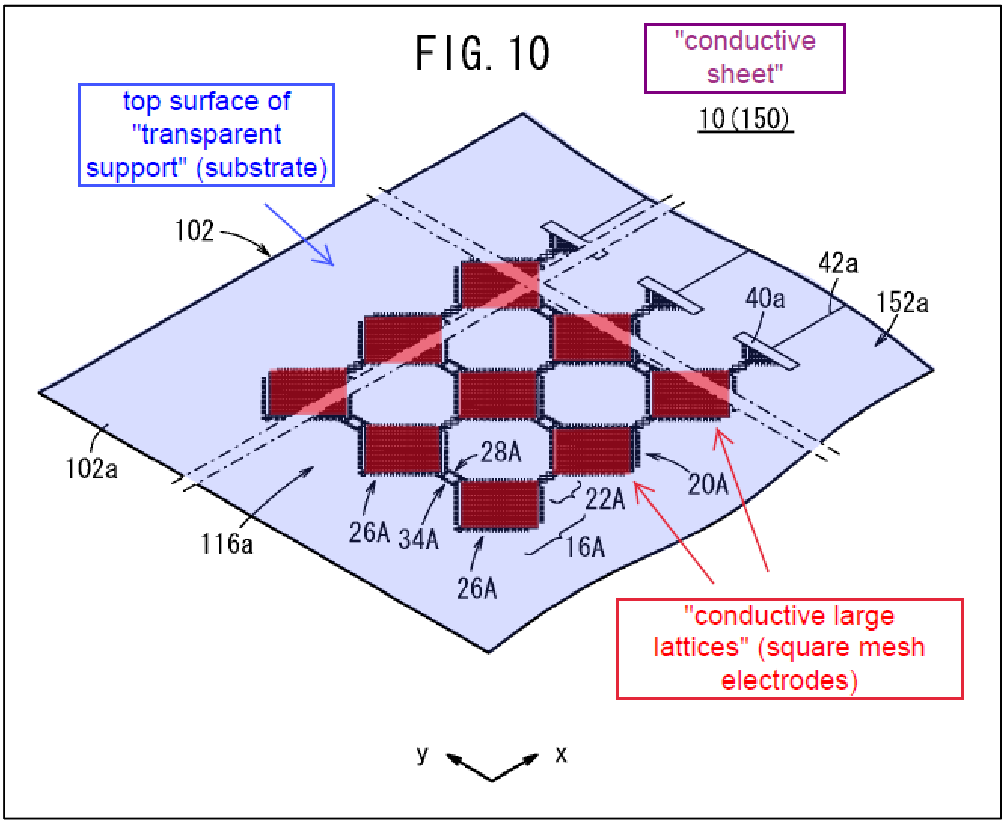
A POSA would have recognized that the checkerboard-like "conductive patterns" (26A/26B) in the "sensing region 150" of Kuriki's "conductive sheet 10" satisfy this limitation. Ex. 1023, ¶ 115.

"drive or sense electrodes" / "a plurality of capacitive nodes formed from drive or sense electrodes":

Kuriki discloses that by forming "the same or different patterns . . . on each side (each of front and back sides) of [] transparent support 102," "an electrode for a touch panel or the like can be easily formed," Ex. 1003, 11:51–56. Kuriki also discloses that these electrodes are for a *capacitive* touch panel. *Id.*, 1:16–20 (stating that Kuriki's "capacitive sheet" is "suitable for use in a projected capacitive touch panel"). Such capacitive touch panels work, Kuriki explains, by "sensing change in an electrostatic capacitance between a human finger and a conductive film to detect the position touched by the fingertip." *Id.*, 1:35–40; Ex. 1023, ¶¶ 117–18.

In Kuriki, the electrodes in the capacitive touch panel are the checkerboard-like "conductive patterns" (26A/26B) in the "sensing region 150" that comprise a

plurality of square (or square-like[4]) "large lattices" (16A/16B) "formed on" each "main surface" (top surface 102a and bottom surface 102b) of the "transparent support 102" (substrate). Ex. 1003, 11:57–12:25, 12:26–39 ("the first large lattices 16A exhibit a lowered electrostatic capacitance in the detection process"), Figs. 10, 12; Ex. 1023, ¶ 119:



A POSA would understand Kuriki's "large lattice" electrodes to be drive and sense electrodes, as described and claimed in the '311 patent. Kuriki's teachings

[4] Technically, the "conductive large lattices 16B" on the bottom are "approximately octagonal" with four long sides and four short sides. Ex. 1003, 14:65–15:4.

closely track the ’311 patent’s disclosure of “[a] drive electrode and a sense electrode [that] may form a capacitive node,” where “the drive and sense electrodes may be capacitively coupled to each other across a space between them.” Ex. 1001, 3:31–39, 4:15–20 (“touch sensor 10 may have drive electrodes disposed in a pattern on one side of a substrate and sense electrodes disposed in a pattern on another side of the substrate”). Ex. 1023, ¶ 120–121.

Kuriki also discloses that “[w]hen a finger comes into contact” with the touchscreen, “signals are transmitted from the first conductive pattern 26A and the second conductive pattern 26B corresponding to the finger touch position to the IC circuit. The finger touch position is calculated in the IC circuit based on the transmitted signals.” *Id.*, 18:46–53; Ex. 1023, ¶¶ 116–118. Again, this closely tracks the ’311 patent’s disclosure that “[w]hen an object touches or comes within proximity of the capacitive node, a change in capacitance may occur at the capacitive node and controller 12 may measure the change in capacitance.” Ex. 1001, 3:44–50. *See also* Ex. 1004, 1:61–64 (“the electrodes used for supplying the signal and sensing the capacitive coupling are often called drive electrodes and sense electrodes, respectively.”); Ex. 1023, ¶¶ 116–118, 120–121.

Accordingly, a POSA would have understood that Kuriki’s square-like “large lattices” (16A/16B) on either surface of the PET transparent support 102 have the same structure and function as the “drive or sense electrodes” which form “a

plurality of capacitive nodes" in the '311 patent, and thus satisfy this claim element. Ex. 1023, ¶¶ 116–118, 120–121.

"made from flexible conductive material configured to bend with the substantially flexible substrate"

Kuriki discloses using silver for its "conductive patterns," including the "conductive large lattices" (16A/16B) which serve as electrodes. Ex. 1003, 27:48–28:38, 29:55–30:33; Ex. 1023, ¶ 122.

A POSA would have understood that the metallic silver from which Kuriki's electrodes are formed is a flexible conductive material configured to bend with its PET substrate ("transparent support" 102). Kuriki discloses that its conductive sheet 10 can be "bent toward the back side of the sensing region 150 (i.e. the back side of the liquid crystal display panel 170)" and thus wrapped around the edges of liquid crystal display panel 170, as depicted in Figure 18 of Kuriki (shown in the above section). The portions of the conductive sheet that are bent are the "terminal wiring regions" (152a/152b). Ex. 1003, 21:8–12, Fig. 15 at S106; Ex. 1023, ¶ 124. These regions include "terminal wiring patterns" (42a/42b) which are formed on the substrate ("transparent support" 102), Ex. 1003, 11:64–12:8, 19:64–21:12, using the same layer of silver as the conductive lattices of the sensing region 150, *id.*, 27:48–28:38, 29:55–30:33; Ex. 1023, ¶ 124. Thus, the silver material that forms Kuriki's conductive lattices (16A/16B) is a "flexible conductive material [silver] configured to bend with the substantially flexible substrate [transparent support]."

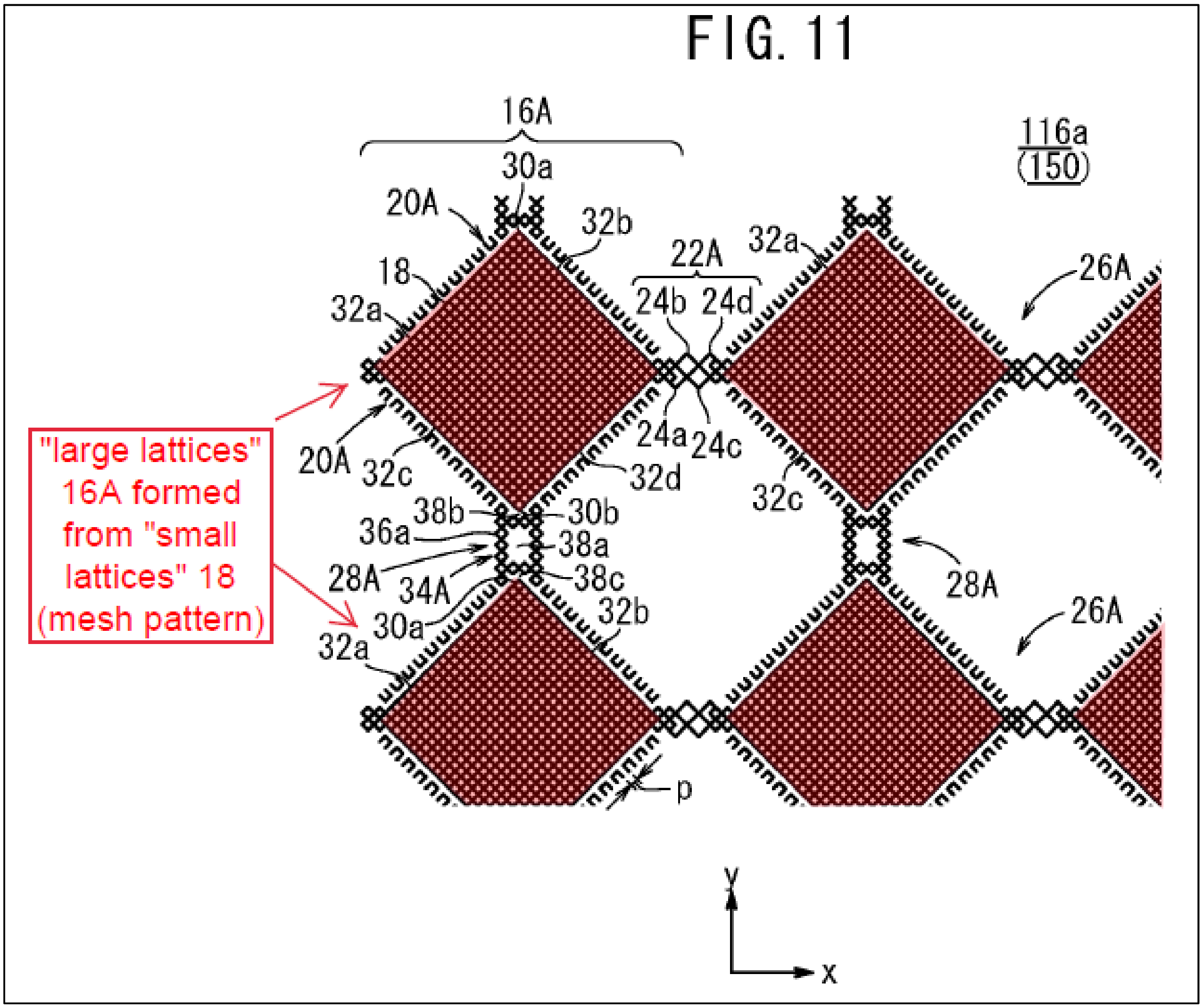
Indeed, numerous contemporary prior art references confirm that electrodes made from silver, such as Kuriki's conductive patterns, are flexible and would bend along with a substantially flexible substrate. *See, e.g.*, Ex. 1023, ¶¶ 122–123 (citing Ex. 1007, 5:17–19, 8:15–16; Ex. 1012, ¶¶ [0008]–[0009], Ex. 1018, 2955, 2962; Ex. 1019, ¶¶ [0025], [0033], [0081]). Moreover, the '311 patent similarly discloses that the electrode pattern in the flexible embodiment depicted in Figure 7 is made from silver, Ex. 1001, 7:44–47 ("electrode pattern of touch-sensitive apparatus 612 made from metal-mesh technology with a copper, silver, or other suitable metal mesh"). This confirms that the silver used to form Kuriki's electrodes is a flexible material that can bend along with its substrate. Ex. 1023, ¶ 122.

1[d]/7[d]: "the flexible conductive material of the drive or sense electrodes comprises first and second conductive lines that electrically contact one another at an intersection to form a mesh grid"

Kuriki discloses that the flexible conductive material (silver) of its electrodes ("conductive large lattices" (16A/16B))) comprises a mesh pattern of small squares that satisfies this limitation. Ex. 1023, ¶¶ 125–126.

Kuriki's large lattices "each contain a combination of two or more small lattices 18." Ex. 1003, 12:13–15. These small lattices may have a "smallest square shape," *id.* at 12:24–25, and therefore form a mesh. As shown in Figures 11 and 13 of Kuriki, the "combination of small lattices 18" is a pattern of connected squares of metallic silver, which constitute "first and second conductive lines that electrically

contact one another at an intersection to form a mesh grid," as claimed. *Id.*, 29:10–28; Ex. 1023, ¶ 125:



Indeed, this is essentially the same mesh pattern that is depicted in Figure 2A of the '311 patent:

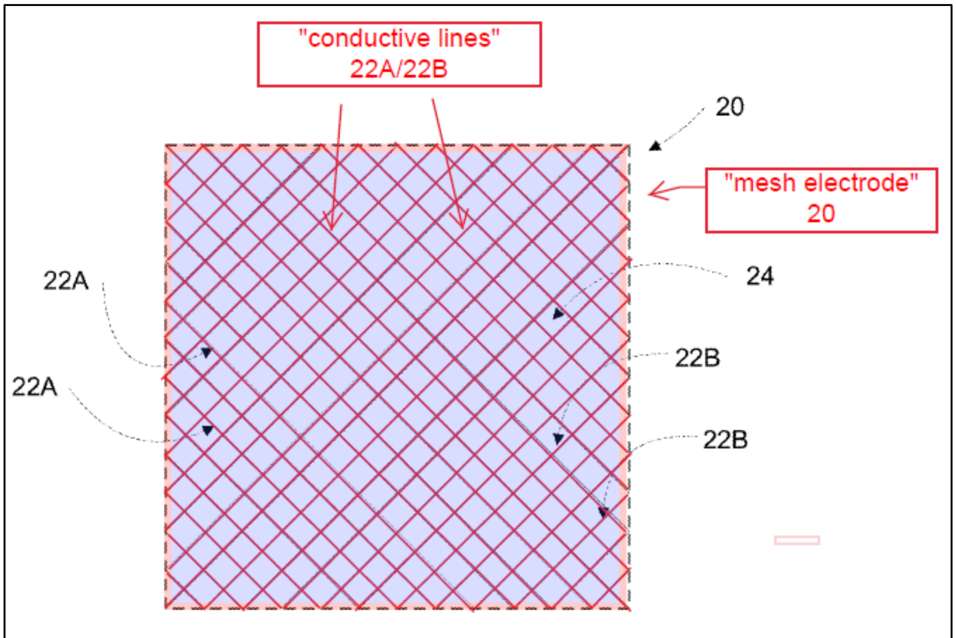


Figure 2A

1[e]/7[e]: "the substantially flexible substrate and the touch sensor are configured to wrap around one or more edges of a display"

This element is satisfied by Kuriki alone or in combination with Mikladal.

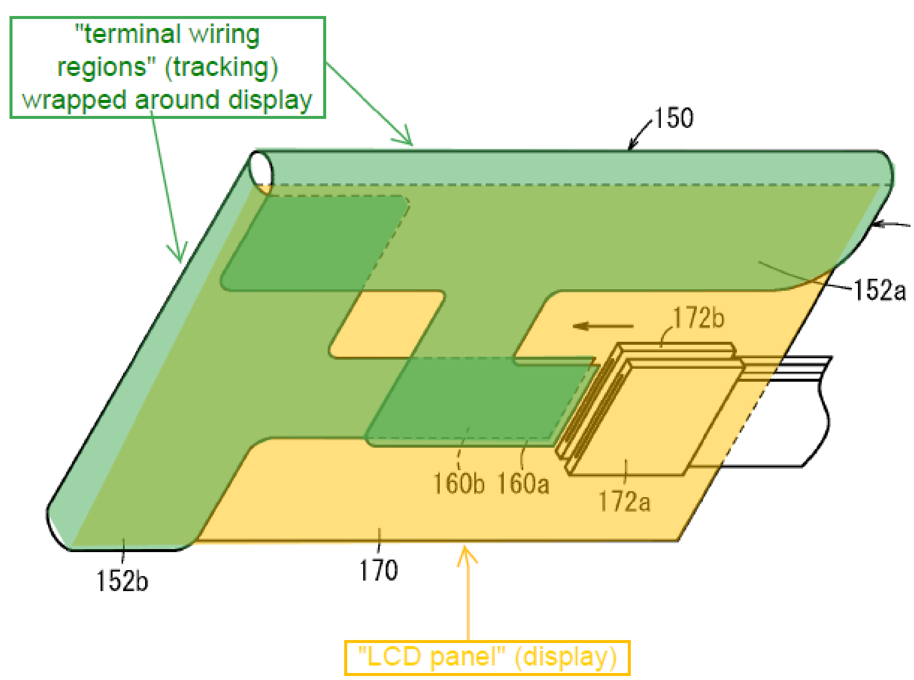
a) Kuriki Alone

To the extent that element 1[e]/7[e] is interpreted to encompass a device (or apparatus) in which the tracking of the touch sensor is configured to wrap around a display edge (as discussed above in Section VI.B), then this limitation is disclosed by Kuriki alone.

Kuriki discloses that the patterned "terminal wiring regions" (152a/152b) of conductive sheet 10 (which, as discussed above, comprises a substantially flexible substrate ("transparent support" 102)) can be "bent toward the back side of the sensing region 150 (i.e. the back side of the liquid crystal display panel 170)," as

depicted in Figure 18 of Kuriki, Ex. 1003, 21:8–12, Fig. 15 at S106; Ex. 1023, ¶¶ 128–129. That is, the terminal wiring regions of Kuriki's conductive sheet are wrapped around the edges of liquid crystal display panel 170. Accordingly, Kuriki teaches that conductive sheet 10—or at least certain portions thereof (the wiring regions)—is configured to wrap around one or more edges of a display:

FIG. 18



b) Kuriki in Combination with Mikladal

Additionally, even under a narrower interpretation of this claim limitation requiring that a *touch-sensitive portion* of the touch sensor be configured for wrapping around a display edge, this limitation would have been obvious based on the combination of Kuriki and Mikladal. While Kuriki does not expressly disclose that its touch-sensitive conductive patterns are wrapped around the edges of its

display, it would have been obvious based on Mikladal to modify Kuriki's touch panel so that the touch-sensitive portions of Kuriki's "conductive sheet" were also wrapped around the edges of the display. Ex. 1023, ¶¶ 130–132

Motivation to Combine: Kuriki and Mikladal both disclose capacitive touch sensors for touchscreens with the same core structures (a metal conductive layer formed on a PET substrate to create a transparent touch sensor that is layered over a display), Ex. 1003, 1:17–20, 12:9–13:9, 18:35–53, 21:3–12, 23:3–23, 27:48–28:38, 29:55–30:33, Figs. 8/10/12/17A–B; Ex. 1004, 2:28–44, 3:34–40, 6:43–63, 12:10–25, 13:27–14:22, Figs. 1–2. Mikladal, in turn, provides an express teaching, suggestion, or motivation for wrapping a touch sensitive film around a display edge::

> Flexibility and/or deformability of the touch sensitive film in combination with the unique sensitivity performance thereof ***opens entirely novel possibilities to implement touch sensing devices***. For example, a touch sensitive film serving as the user interface of a mobile device ***can be bent or formed to extend to the device edges*** so that the touch sensitive film can cover even the entire surface of the device. In a touch sensitive film covering different surfaces of a three-dimensional device, ***there can be several touch sensing regions for different purposes***. One sensing region can cover the area of a display to form a touch screen. ***Other sensing regions e.g. at the sides of the device can be configured to serve as touch sensitive element replacing the conventional mechanical buttons, e.g. the power button.***

Ex. 1004, 7:31–44 (emphasis added); Ex. 1023, ¶ 133. Accordingly, a POSA would have been motivated to wrap touch-sensitive portions of Kuriki's conductive sheet (i.e., the sensing region 150 containing the "large lattice" electrodes 16A/16B) around an edge of Kuriki's display, in order to form sensing regions on the side of its touch panel, as taught by Mikladal. *Id.*

Indeed, these advantages of wrapping a touch sensitive element around the side of a display would have been well known to a POSA at the time, as they were in fact expressly taught by a number of other contemporary prior art references. *See* Ex. 1008, ¶¶ [0063]–[0064], [0067] ("a separate side key is not required . . . , thereby simplifying the manufacturing process thus to reduce the manufacturing cost . . . and make the enhanced appearance of the terminal"); Ex. 1015, 13:42–14:8 ("on-screen options such as virtual VB may be presented in the active portion A' of active region A that is folded over to cover sidewall SW"); Ex. 1016, 22:16–23:12 ("replaces the function of any mechanical buttons or switches used in prior art mobile phones"); Ex. 1023, ¶ 134.

For at least these reasons, the prior art provided a teaching, suggestion, or motivation to wrap touch-sensitive portions of Kuriki's conductive sheet around an edge of its display. The use of Mikladal's technique in this manner constitutes nothing more than "application of a known technique [Mikladal's teaching of wrapping a flexible touch sensor around the edges of a display] to a piece of prior

art ready for the improvement [Kuriki's flexible touch sensor for a touchscreen display]." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007); *see also id.* at 415–19 (obvious to implement known techniques to improve similar devices and methods in known ways to yield predictable results, especially where some teaching, suggestion or motivation exists to do so).

Reasonable Expectation of Success: Modifying Kuriki's flexible conductive sheet using these teachings from Mikladal would have been well within the skill of a POSA. Ex. 1023, ¶ 135. Such a modification could be implemented, for example, by expanding the touch-sensitive portions of Kuriki's conductive sheet (i.e., the sensing region 150 containing the "large lattice" electrodes 16A/16B) and wrapping those expanded touch-sensitive portions around the edges of Kuriki's display. *Id.*

As discussed above, Kuriki discloses that its PET substrate and the silver conductive lines of its "terminal wiring patterns" are wrapped around the edges of an underlying LCD panel, Ex. 1003, 21:8–12, Figs. 15/18; Ex. 1023, ¶ 137. Additionally, as discussed above in regards to element 1[c]/7[c], a POSA would have recognized that the touch-sensitive regions of Kuriki's conductive sheet (containing the silver "conductive patterns" 26A/26B discussed above) would have been similarly flexible and amenable to being wrapped around the edges of the underlying display. *Id.*

Mikladal, which expressly disclosed wrapping a touch-sensitive conductive network of metal nanowires around the edge of a display (Ex. 1004, 12:10–11, 6:43–63, 7:19–44), would have given a POSA a reasonable expectation of success in modifying Kuriki in this manner. Indeed, Kuriki and Mikladal each disclose using the same materials for the substrate and the conductive layer that forms the touch-sensitive electrodes: metal wires/lines formed on a flexible PET substrate. Ex. 1003, 23:3–23, 27:48–28:38, 29:55–30:33; Ex. 1004, 12:10–25, 6:43–63; Ex. 1023, ¶ 136. Moreover, both Kuriki and Mikladal come from the same field of endeavor—transparent capacitive touch sensors for touchscreen devices. Ex. 1003, 1:17–20, 18:35–53; Ex. 1004, 3:34–40; Ex. 1023, ¶ 136. And both Kuriki and Mikladal disclose touch sensors in which a conductive layer is formed on a substrate, and the touch sensor is then layered on top of a display (such as an LCD). Ex. 1003, 12:9–13:9, 21:3–12, Figs. 8/10/12/17A–B; Ex. 1004, 13:27–14:22, 2:28–44, Figs. 1–2; Ex. 1023, ¶ 136.

A POSA would also have been aware of numerous contemporary prior art references describing how metal (in particular, silver) mesh electrodes, such as the "large lattices" used in the sensing region of Kuriki's conductive sheet, are flexible and can be bent around the edge of a device. Ex. 1007, 9:17–22, 22:13–15, 8:13–21 (noting that a silver/copper mesh electrode disposed on a PET substrate "may be substantially planar and flexible"); Ex. 1015, 8:64–9:11, 13:4–14:8; Ex. 1012,

¶¶ [0008]–[0009] (noting that copper/silver "mesh" electrodes are "malleable" and "can be readily flexed or kinked without damage"); Ex. 1018, 2955, 2962 (explaining that "outstanding flexibility makes the Ag NW [silver nanowire] electrode attractive for flexible electronics," such as "capacitive touch screens."); Ex. 1019, ¶¶ [0025], [0033], [0081] (describing the "favorable physical and mechanical properties" of "robust and flexible" silver nanowire matrices for use in "touch screens"); Ex. 1023, ¶ 137.

Thus, a POSA would have appreciated that Kuriki's electrodes—like Mikladal's—"can be bent or formed to extend to the device edges" so that the "the sides of the device can be configured to serve as touch sensitive element," Ex. 1004, 7:34–44. This would be nothing more than the "application of a known technique [wrapping a touch sensor around the edge of a touchscreen device's display] to a piece of prior art ready for the improvement [Kuriki]." *KSR*, 500 U.S. at 417.

7[f]: "one or more computer-readable non-transitory storage media embodying logic that is configured when executed to control the touch sensor."

A POSA would have recognized that Kuriki incorporates logic that is executed on an integrated circuit and configured to control the touch sensor, which satisfies this claim element. Kuriki discloses that the sensing region of its conductive sheet is "electrically connected" (via the "terminal wiring") "to an IC circuit [integrated circuit] for position calculation, etc." Ex. 1003, 21:8–17, 18:35–53 ("The

finger touch position is calculated in the IC circuit based on the transmitted signals"). Such an integrated circuit would be understood as executing instructions ("logic") that is stored on ROM or other non-volatile memory (computer-readable non-transitory storage media), since that is how integrated circuits function. Ex. 1023, ¶ 138.

Indeed, the '311 patent itself discloses that "a computer-readable storage medium may include a semiconductor-based or other ICs," Ex. 1001, 8:11–34, and Mikladal explains that such "processing means can comprise any hardware and electronics as well as software tools for generating and controlling signals needed in operating the touch sensitive film," Ex. 1004, 8:14–26; Ex. 1023, ¶ 139. Thus, this element would be at a minimum obvious in view of Kuriki's disclosure of an integrated circuit to calculate the finger touch position. *Id.*

2. Claims 2 and 8

"The [apparatus of claim 1/device of claim 7], wherein the touch sensor further comprises tracking disposed on the substantially flexible substrate configured to provide drive or sense connections to or from the drive or sense electrodes and configured to bend with the substantially flexible substrate."

Kuriki discloses the "tracking" of this dependent claim element. As discussed above, Kuriki discloses "terminal wiring patterns" 42a and 42b, which are made of silver and formed on the PET "transparent support" (102), in the "terminal wiring regions" (152a/152b) of Kuriki's conductive sheet. Ex. 1003, 11:64–12:8, 19:64–

21:12, 27:48–28:38, 29:55–30:33. Kuriki further teaches that these terminal wiring patterns are wrapped along with the underlying PET support around the edges of the touch panel. *Id.*, 21:8–12, Fig. 15 at S106, Fig. 18. And Kuriki discloses that these terminal wiring patterns extend from the checkerboard formation of electrodes ("conductive patterns" 26A/26B) and are "electrically connected to an IC circuit for position calculation, etc." via "connectors 172a, 172b," Ex. 1003, 21:13–17, 18:35–53, just like the '311 patent's "tracks 14" which connect the electrodes of its "touch sensor 10" to its "controller 12," Ex. 1001, 5:15–55; Ex. 1023, ¶¶ 140–141.

3. Claims 3 and 9

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines are made from one of carbon nanotubes, copper, silver, a copper-based material, or a silver-based material."

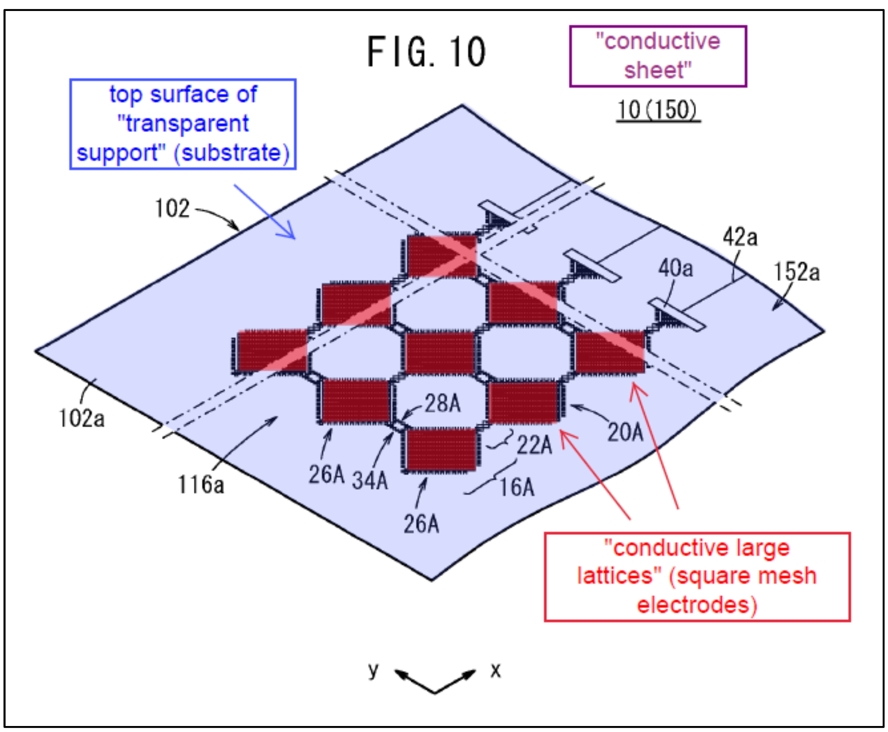
Kuriki discloses that the conductive lines of its "large lattice" electrodes are made from silver, and thus satisfies this dependent claim element. Ex. 1003, 27:48–28:38, 29:55–30:33; Ex. 1023, ¶ 142.

4. Claims 4 and 10

"The [apparatus of claim 1/device of claim 7], wherein the touch sensor comprises: a single-layer configuration with drive and sense electrodes disposed only on a first surface of the substantially flexible substrate; or a two-layer configuration with drive electrodes disposed on the first surface of the substantially flexible substrate and sense

electrodes disposed on a second surface of the substrate opposite the first surface."

Kuriki teaches or suggests this dependent claim element. First, its capacitive touch panel has a *two-layer configuration* in which one checkerboard pattern (26A) of "large lattice" electrodes (16A) is formed on a first surface 102a of the PET "transparent support" and another pattern (26A) of "large lattice" electrodes (16B) is formed on the opposite surface 102b of the PET transparent support, as depicted in Figs. 10 and 12 of Kuriki, Ex. 1003, 11:57–12:25; Ex. 1023, ¶ 143. As discussed above in regards to element 1[c]/7[c], a POSA would have understood that Kuriki's square-like "large lattices" (16A/16B) on either surface of the PET transparent support 102 are "drive or sense electrodes" which form "a plurality of capacitive nodes" as claimed in the '311 patent. Ex. 1023, ¶¶ 116–118, 144:



Second, a POSA would have understood that capacitive sensing using such a two-layer electrode configuration commonly entailed using one layer for the drive electrodes and the other layer for the sense electrodes. Indeed, a separate international patent application filed by the named inventor of Kuriki described using the same type of "lattice" electrodes in a two layer "mutual capacitance" configuration, in which a "voltage signal for the touch position detection is sequentially supplied to the first conductive patterns 22A [drive electrodes], and the second conductive patterns 22B are sequentially subjected to sensing [sense electrodes]." Ex. 1017, 26:5–10; *see also id.*, 16:30–25:18; Ex. 1023, ¶ 145. Thus, it would have been obvious, at a minimum, to use Kuriki's two-layer electrode structure in the claimed drive/sense electrode configuration.

5. Claims 5 and 11

"The [apparatus of claim 1/device of claim 7], wherein the touch sensor is a mutual-capacitance touch sensor or a self-capacitance touch sensor."

Kuriki teaches or suggests this dependent claim element. A POSA would have understood that Kuriki's two-layer electrode configuration was suitable and would have been used in both "self or mutual capacitance" implementations. Kuriki discloses transmitting signals from each of its two sets of conductive patterns (26A and 26B) "to an IC circuit for position calculation or the like." Ex. 1003, 18:46–53; Ex. 1023, ¶ 146. And a separate international patent application filed by the named

inventor confirms that "lattice" electrodes such as those disclosed by Kuriki can be used in both "self or mutual capacitance" implementations. Ex. 1017, 25:19–26:29 (explaining how those "lattice" electrodes), 16:30–25:18 (describing Kuriki's "lattice" electrodes); Ex. 1023, ¶ 147.

6. Claims 6 and 12

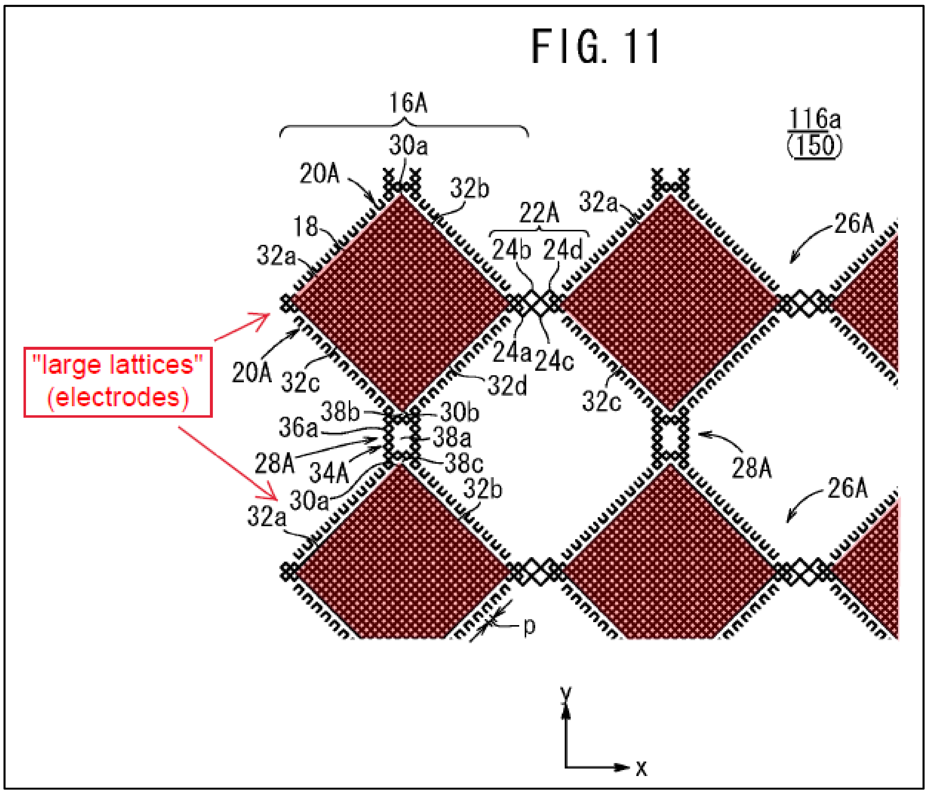
"The [apparatus of claim 1/device of claim 7], wherein the touch sensor further comprises electrically-isolated structures made of conductive material comprising a conductive mesh."

Kuriki discloses this dependent claim element. Its capacitive sheet includes "electrically isolated" "insulation patterns," as illustrated by 28A/34A/36A and 28B/34B/36B in Figs. 10–14. These insulation patterns are "unconnected" to the conductive "large lattice" electrodes and "disposed between" those large lattice electrodes, Ex. 1003, 12:40–46, 12:64–13:3, 13:63–14:14, 15:60–16:7; Ex. 1023, ¶ 148. Kuriki further discloses that these "insulation patterns" are made of conductive material comprising a conductive mesh, explaining that the insulation portions are "composed of a plurality of the small lattices 18." Ex. 1003, 13:63–14:14, 15:60–16:7; Ex. 1023, ¶ 148.

7. Claims 13 and 16

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines are substantially orthogonal to one another."

Kuriki discloses this dependent claim element. The first and second conductive lines of its "large lattice" electrodes (16A/16B) are substantially orthogonal to one another, as shown in Figs. 11 and 13 of Kuriki, Ex. 1023, ¶ 149:



8. Claims 15 and 18

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines are made of fine lines of

metal having a thickness of approximately 5 micrometers or less and a width of approximately 10 micrometers or less."

Kuriki satisfies this dependent claim element. Regarding the conductive silver lines used in its "large lattice" electrodes, it discloses that the "line width of each conductive pattern is . . . most preferably 5 to 9 μm," Ex. 1003, 29:10–13, and that "the thickness of the layer of the conductive metal on the conductive pattern is . . . preferably 0.1 μm or more but less than 3 μm," *id.*, 30:8–15; Ex. 1023, ¶ 150.

B. Ground II: Claims 14 and 17 Are Unpatentable Under 35 U.S.C. § 103 Over the Combination of Kuriki, Mikladal, and Philipp.

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines are non-linear."

Philipp discloses the use of mesh electrodes in which the conductive lines that make up the mesh electrode are "wavy lines . . . formed of a series of curves," which "avoid creating moiré patterns when overlaying a display" and "long linear stretches of fine metal line," as depicted in Figure 4 of Philipp, Ex. 1005, ¶¶ [0030], [0041]–[0045]; Ex. 1023, ¶ 154:

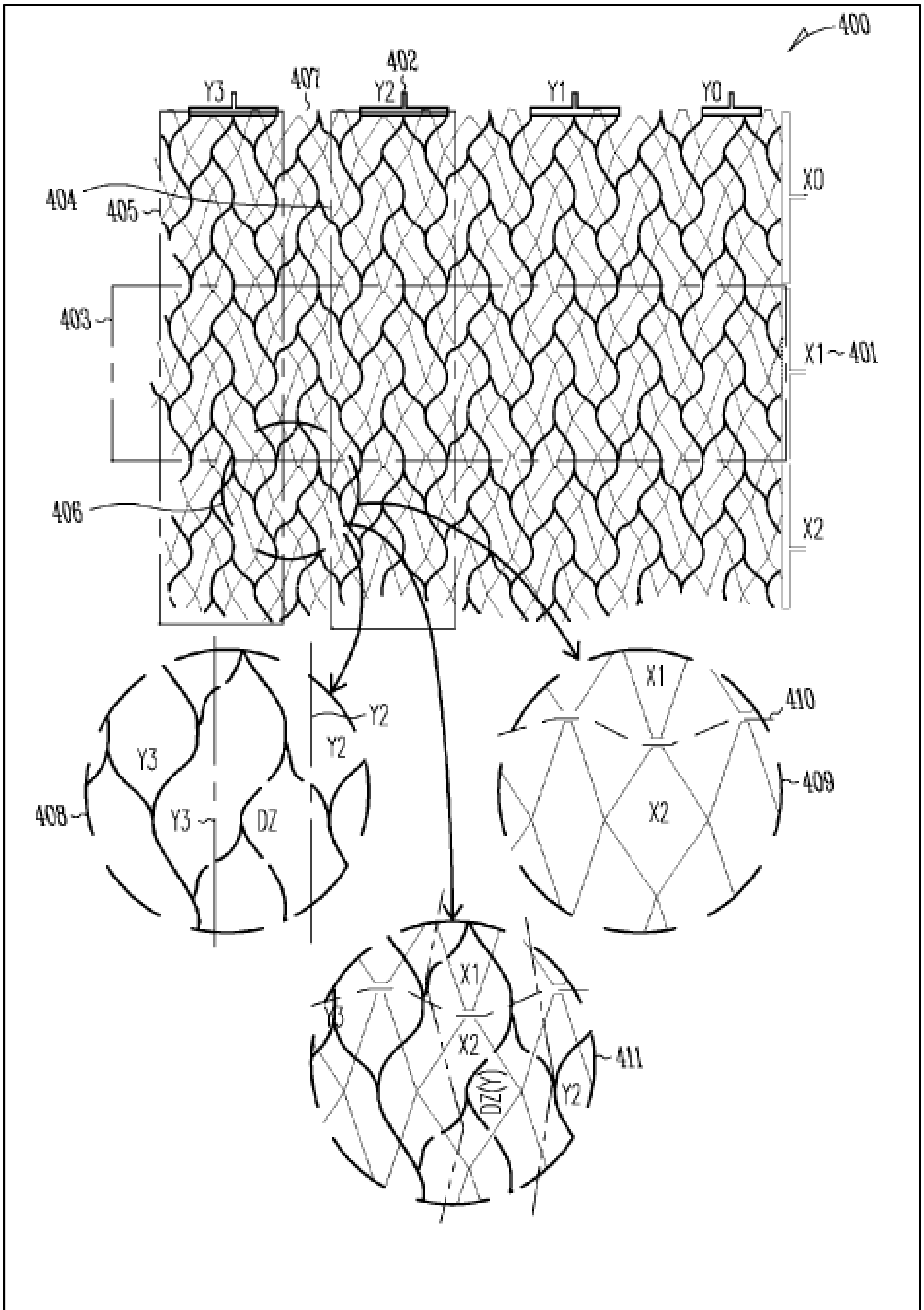


Fig. 4

It would have been obvious to a POSA to use Philipp's technique of making conductive lines in a mesh electrode (such as the silver lines in Kuriki's "lattice electrodes") non-linear in Kuriki's capacitive touch panel. Ex. 1023, ¶¶ 151–152.

Motivation to Combine: Philipp provides an express teaching, suggestion, or motivation to implement the technique of using non-linear lines in Kuriki's "large lattice" electrodes: "to avoid creating moiré patterns between the display and the touchscreen." Ex. 1005, Abstract, ¶¶ [0006], [0030]–[0031] ("wavy lines are used to avoid long linear stretches of fine metal line, reducing the probability of causing interference patterns"), [0042]. Kuriki itself identifies this same problem, warning about "moire [being] significantly generated due to the conductive metal portion," which can result in "the touch panel using the conductive pattern [having] a poor visibility." Ex. 1003, 29:10–28; Ex. 1023, ¶ 155.

Reasonable Expectation of Success: Modifying Kuriki's "large lattice" electrodes using these teachings from Philipp would have been well within the skill of a POSA. Philipp, like Kuriki, is directed to mesh electrodes for use in capacitive touch sensors. Ex. 1005, ¶¶ [0018]–[0019], [0042], Fig. 4; Ex. 1023, ¶ 151, 156. And Kuriki expressly noted that "curved" or "wavy" silver lines, such as those taught by Philipp, could be implemented into its lattices. Ex. 1003, 18:54–64 ("each side of the small lattice 18 may have a straight line shape, a curved shape, or an arc shape . . . each side may have a wavy shape containing outwardly protruding arcs and inwardly protruding arcs formed continuously . . . [or] a sine curve shape"); Ex. 1023, ¶ 153, 156. Accordingly, use of Philipp's technique in this manner constitutes nothing more than "application of a known technique [non-linear conductive lines

in a mesh electrode] to a piece of prior art ready for the improvement [Kuriki's mesh electrodes]." *KSR*, 500 U.S. at 417.

C. Ground III: Claims 19 and 20 Are Unpatentable Under 35 U.S.C. § 103 Over the Combination of Kuriki, Mikladal, and Rappoport.

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines of the flexible conductive material of the drive or sense electrodes is wider at the one or more edges of the display."

Rappoport discloses that at the edges of the device, "[c]onductive traces . . . such as control lines 62" that are "formed on the surface of [a] substrate 60" are "enlarged (e.g. widened and/or thickened) in the vicinity of bend axis 56" along which the conductive lines are bent around the edge of the device, as illustrated by Figs. 7–9, Ex. 1006, ¶¶ [0038]–[0043]; Ex. 1023, ¶ 160:

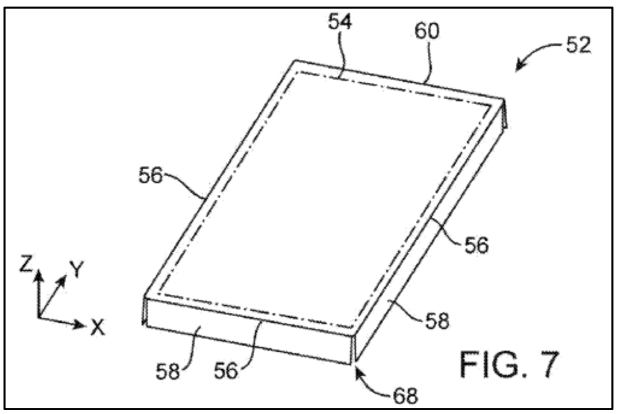


FIG. 7

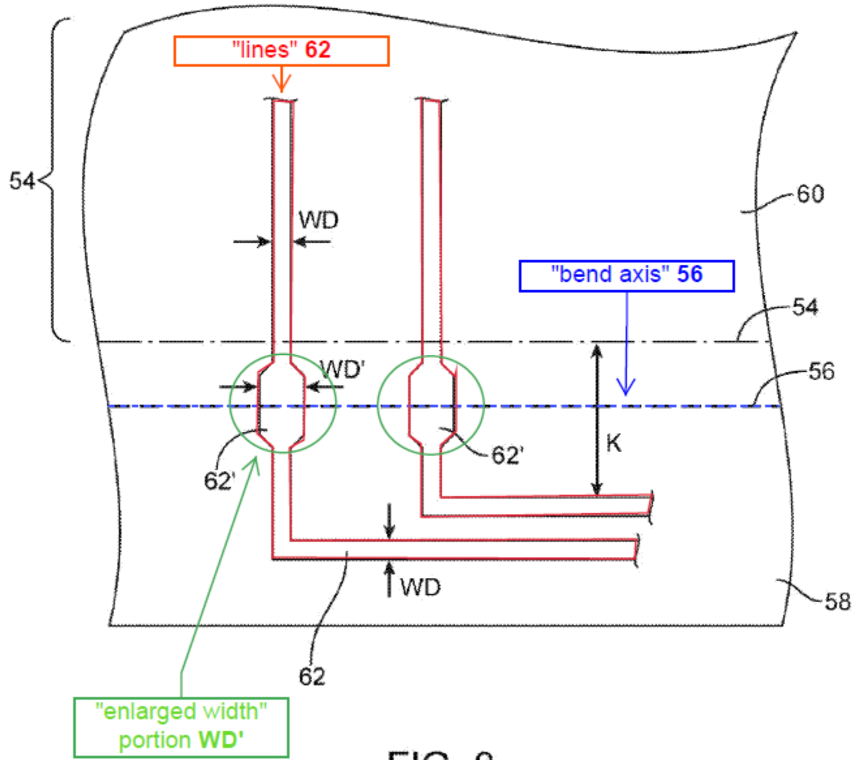

"lines" 62
54
WD
60
"bend axis" 56
54
WD'
56
K
62'
62'
WD
58
62
"enlarged width" portion WD'

FIG. 8

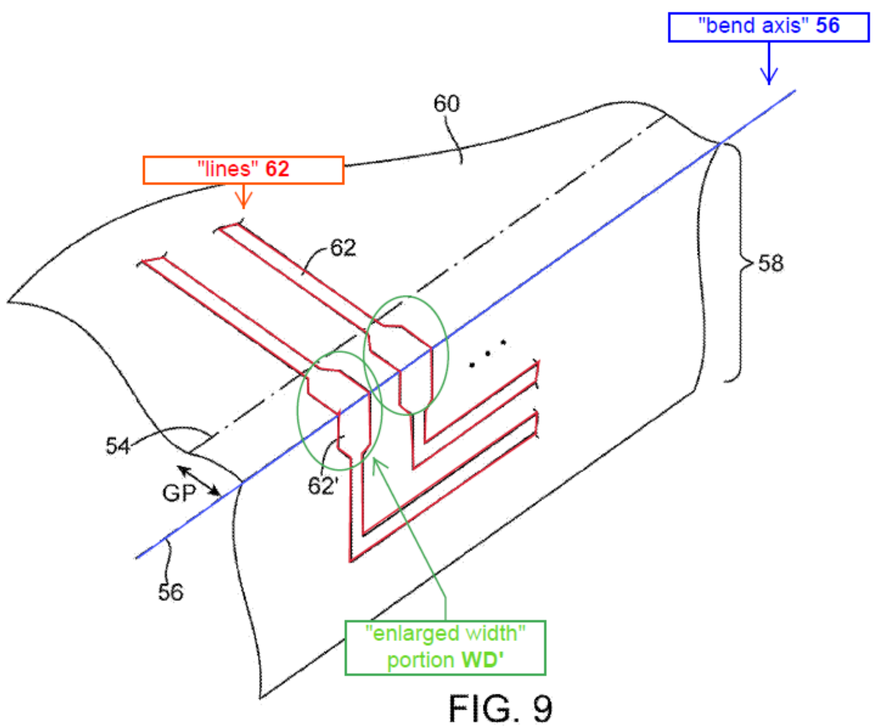

"bend axis" 56
60
"lines" 62
62
58
54
GP
62'
56
"enlarged width" portion WD'

FIG. 9

It would have been obvious to a POSA to use Rappoport's technique of making conductive lines in a capacitive touch sensor wider at the edge of a display on the conductive lines in the "large lattice" electrodes of Kuriki's capacitive touch panel (as modified by Mikladal). Ex. 1023, ¶¶ 157-158.

Motivation to Combine: Rappoport provides an express teaching, suggestion, or motivation to implement the technique of making conductive lines wider at the edge of a display in Kuriki's "large lattice" electrodes: to "help ensure that traces 62 are not cracked or otherwise damaged" when bent around the edge. Ex. 1006, ¶ [0043]; Ex. 1023, ¶¶ 161–162.

Reasonable Expectation of Success: Modifying Kuriki's "large lattice" electrodes using these teachings from Rappoport would have been well within the skill of a POSA. Rappoport, like Kuriki and Mikladal, is directed to devices featuring capacitive touch screen sensors overlaying a display, Ex. 1006, ¶¶ [0029], [0049]. Ex. 1023, ¶¶ 157, 163. And Kuriki expressly suggests making conductive lines wider as their distance from the center of an electrode increases: "the first terminal wiring patterns 42a farthest from the center of the arrangement of the first conductive patterns 26A may have the largest line width, and the first terminal wiring pattern 42A closer to the arrangement center may have a smaller line width." Ex. 1003, 21:55–65; Ex. 1023, ¶ 163. Accordingly, the use of Rappoport's technique in this manner constitutes nothing more than "application of a known technique

[making conductive lines wider at the edge of a display] to a piece of prior art ready for the improvement [Kuriki's "lattice" electrodes]." *KSR*, 500 U.S. at 417.

D. Ground IV: Claims 1–13, 15–16, and 18 Are Unpatentable Under 35 U.S.C. § 103 Over the Combination of Moran and Joo.

Claims 1–13, 15–16, and 18 of the '311 patent are obvious over the combination of Moran and Joo. Like the '311 patent, Moran discloses a capacitive touch sensor, in which silver/copper mesh electrodes are formed on a flexible PET substrate. Joo discloses wrapping a touch sensor around the edges of a touchscreen display in order to create touch-sensitive regions on the sides of that device. As explained further below, it would have been obvious for a POSA to use Joo's teachings to improve Moran's touchscreen device, and thus satisfy the above-listed claims. Ex. 1023, ¶¶ 164–165.

Because neither Moran nor Joo was before the Examiner, this Petition does not raise the same or substantially the same prior art or arguments previously considered by the Examiner. 35 U.S.C. § 325(d). In particular, Joo discloses the claim limitation that the Examiner believed was missing from the prior art and that resulted in the allowance of the '311 patent: a "touch sensor [] configured to wrap around one or more edges of a display." Ex. 1002 at 20–24 (September 24, 2015 Reasons for Allowance).

1. Claims 1 and 7

1[preamble]/7[preamble]: "An [apparatus/device] comprising:"

To the extent the preamble is limiting, it is disclosed by Moran. Moran discloses "contact or proximity sensors for touch input of information or instructions into electronic devices (e.g., computers, cellular telephones, etc.)," in the form of a "'touch screen' sensor." Ex. 1007, 6:7–11; Ex. 1023, ¶ 166.

1[a]/7[a]: "a substantially flexible substrate"

Moran discloses a substantially flexible substrate: a "light transparent substrate 130" made of PET, Ex. 1007, 7:16–26, which Moran describes as "substantially planar and flexible," *id.*, 8:13–16. Indeed, the '311 patent discloses PET as a "suitable material" for its substrate. Ex. 1001, 2:38–40; Ex. 1023, ¶ 167.

1[b]/7[b]: "a touch sensor disposed on the substantially flexible substrate"

Moran discloses a touch sensor disposed on the substantially flexible substrate. Moran discloses "at least two electrically conductive micropatterns disposed on or in the visible light transparent substrate," Ex. 1007, 4:18–26, which are connected to circuitry that "driv[es] the conductive micropatterns with electrical signals for the purpose of capacitively detecting the presence or location of a touch event to an information display," *id.*, 6:7–26; Ex. 1023, ¶ 168.

1[c]/7[c]: "the touch sensor comprising [drive or sense electrodes/a plurality of capacitive nodes formed from drive

or sense electrodes] made of flexible conductive material configured to bend with the substantially flexible substrate"

A POSA would have recognized that Moran's electrically conductive micropatterns satisfy this limitation. Ex. 1023, ¶ 169.

"drive or sense electrodes" / "a plurality of capacitive nodes formed from drive or sense electrodes":

Moran discloses that "both conductive micropatterns form at least a portion of a touch sensor, for example a touch screen sensor." Ex. 1007, 9:6–7. Its touch sensor "may be . . . capacitive," and its "micropatterns" "are particularly useful for projected *capacitive* touch screen sensors, *id.*, 7:4–9. Moran further discloses that the two micropatterns "are electrically isolated" from one another, *id.*, 4:18–24, 6:15–26; and that controlling circuitry "*drive[s]*" certain conductive micropattern sensors and "*measure[s]*" other conductive micropattern sensors in order to "make mutual capacitance measurements of the transparent sensor element." Ex. 1007, 32:21–29 (emphasis added). A POSA would have understood this to mean that each pair of conductive micropatterns in Moran comprise drive and sense electrodes, which together form a capacitive node. *Id.*, 6:7–26; Ex. 1023, ¶ 170. Indeed, a co-pending patent application that shared a common inventor (Frey) and assignee (3M) with Moran refers to the same type of "conductive micropatterns" disclosed by Moran as "electrodes." Ex. 1013, ¶¶ [0110], [0117]; Ex. 1023, ¶ 170.

"made from flexible conductive material configured to bend with the substantially flexible substrate"

Moran discloses that the conductive lines of its conductive micropattern sensors are made from metal, such as copper or silver, Ex. 1007, 22:13–15, and that its sensor is "substantially planar and flexible," *id.*, 8:13–16; Ex. 1023, ¶ 171. Thus, a POSA would have understood that the metal from which Moran's electrodes are formed is a flexible material configured to bend with its PET substrate (light transparent substrate 130). Ex. 1023, ¶ 172. Indeed, numerous prior art references confirm that electrodes made from silver, (which Moran discloses as suitable for its micropatterns) are flexible and would bend along with a substantially flexible substrate. *See, e.g.*, *id.* (citing Ex. 1003, 21:8–12, Ex. 1012, ¶¶ [0008]–[0009]; Ex. 1018, 2955, 2962; Ex. 1019, ¶¶ [0025], [0033], [0081]). Moreover, the '311 patent similarly discloses that its electrode pattern in the flexible embodiment depicted in Figure 7 is made from silver or copper. Ex. 1001, 7:44–47. This confirms that the silver/copper disclosed by Moran are flexible materials that can bend along with a substrate. *See* Ex. 1023, ¶ 122.

1[d]/7[d]: "the flexible conductive material of the drive or sense electrodes comprises first and second conductive lines that electrically contact one another at an intersection to form a mesh grid"

Moran discloses that the flexible conductive material of its electrodes comprises "regions with two dimensional meshes (or simply, meshes), where a plurality of linear micropattern features (often referred to as conductor traces or metal traces) such as micropatterned lines define enclosed open areas within the

mesh," Ex. 1007, 9:17–22, as illustrated by Figure 2 of Moran (below), Ex. 1023, ¶ 173. As is evident from the figure, these micropatterned lines constitute "first and second lines that electrically contact one another at an intersection to form a mesh grid":

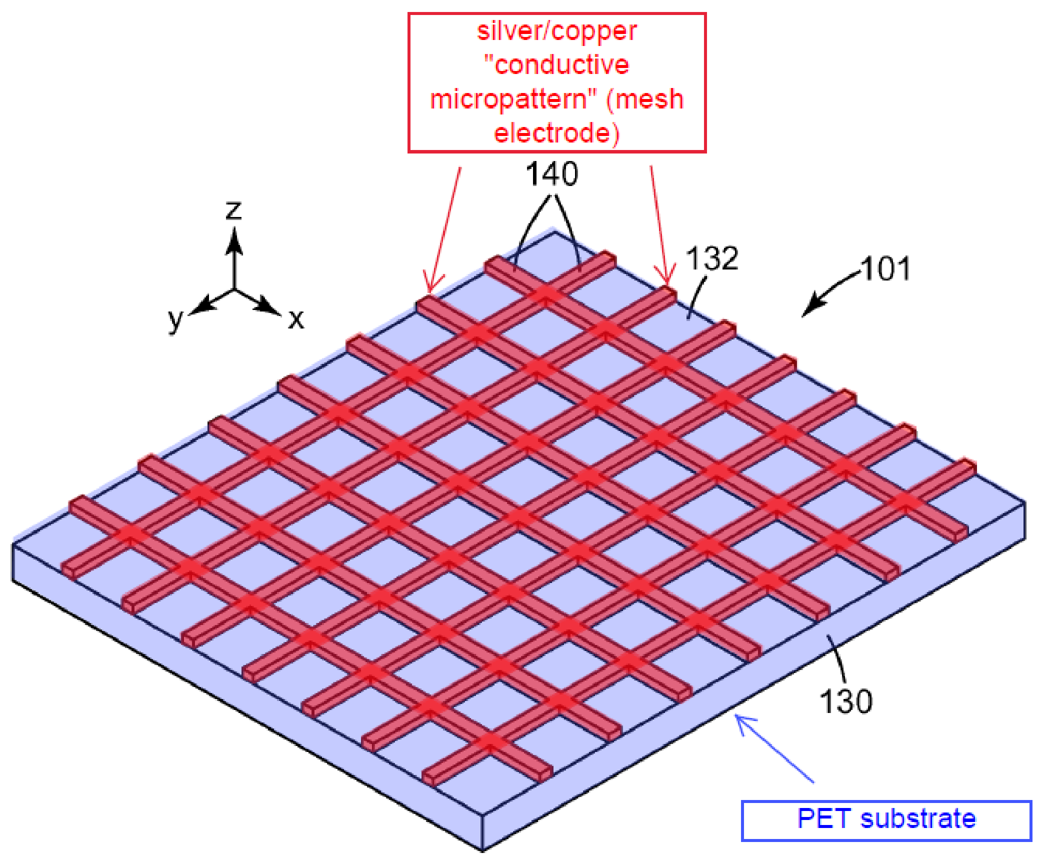


Fig. 2

1[e]/7[e]: "the substantially flexible substrate and the touch sensor are configured to wrap around one or more edges of a display"

This limitation would have been obvious based on the combination of Moran and Joo. Moran discloses that its substrate and sensor are "substantially planar and flexible," Ex. 1007, 8:13–16, but does not expressly discuss wrapping them around

a display edge, Ex. 1023, ¶ 174. Based on the teachings of Joo, it would have been obvious for a POSA to modify Moran's flexible capacitive touch screen sensor to wrap that touch sensor around the edges of an underlying display. *See* Ex. 1023, ¶¶ 177–183.

Motivation to Combine: Moran and Joo each disclose touch sensors for touchscreens with similarly layered structures (a conductive element formed on a transparent substrate, which is then layered over a display), Ex. 1007, 4:18–26, 6:30–7:3, Fig. 2; Ex. 1008, ¶¶ [0060]–[0063], Fig. 7. Ex. 1023, ¶¶ 175, 181. Joo, in turn, teaches that when "the touch input portion for generating input when being touched is extendingly formed at the side surface portion of the cover as well as the upper surface portion thereof . . . a separate side key is not required to be mounted at the side surface of the terminal for generating input, thereby simplifying the manufacturing process thus to reduce the manufacturing cost and make the enhanced appearance of the terminal." Ex. 1008, ¶ [0067]; Ex. 1023, ¶ 176. Indeed, the advantages of wrapping a touch sensitive element around the side of a display were expressly taught by a number of other contemporary prior art references, as discussed above in Section VI.B. Ex. 1004, 7:31–44; Ex. 1015, 13:42–14:8; Ex. 1016, 22:16–23:12; Ex. 1023, ¶¶ 178–179.

Therefore, Joo and other prior art provides an express teaching, suggestion, or motivation for a POSA to wrap Moran's flexible touch sensor around the sides of

the device to create additional touch-sensitive regions. *See* Ex. 1023, ¶¶ 177–183. And the use of Joo's teachings in this manner constitutes nothing more than "application of a known technique [Joo's teaching of wrapping a touch sensor around the edges of a touchscreen display] to a piece of prior art ready for the improvement [Moran's flexible capacitive touch sensor for a touchscreen device]." *KSR*, 550 U.S. at 417 (2007); *see also id.* at 415–419.

***Reasonable Expectation of Success*:** Modifying Moran's flexible touch sensor using these teachings from Joo would have been well within the skill of a POSA. Ex. 1023, ¶ 180. The modification could be implemented, for example, by expanding the touch-sensitive portions of Moran's touch sensor (i.e., the portions containing the mesh electrodes) and wrapping those expanded touch-sensitive portions around the edges of Moran's display. *Id.*

As discussed above for element 1[c]/7[c], Moran's substrate and mesh electrodes disposed thereon are "substantially planar and flexible." Ex. 1007, 8:15–16; Ex. 1023, ¶ 182. Moreover, both Moran and Joo come from the same field of endeavor: transparent touch sensors for use in touchscreen devices. Ex. 1007, 7:4–9, 6:7–26; Ex. 1008, ¶ [0037]; Ex. 1023, ¶ 181. And both Moran and Joo disclose touch sensors in which a touch-sensitive layer is formed on an underlying transparent substrate, and the touch sensor is then layered on top of a display (such as an LCD or OLED). Ex. 1007, 5:28–6:6, 6:30–7:3; Ex. 1008, ¶¶ [0060]–[0062], Fig. 7; Ex.

1023, ¶ 181. Accordingly, modifying Moran in this manner would not have required changes to the underlying structure of Moran's flexible touch sensor, nor to the materials used to construct its elements. *Id.*

A POSA would also have been aware of numerous contemporary prior art references describing how copper or silver mesh electrodes layered on a PET substrate were flexible and could be bent around the edge of a device. Ex. 1003, 21:8–12, Figs. 15/18; Ex. 1004, 12:10–11, 6:43–63, 7:19–44; Ex. 1015, 8:64–9:11, 13:4–14:8; Ex. 1012, ¶¶ [0008]–[0009] (noting that copper/silver "mesh" electrodes are "malleable" and "can be readily flexed or kinked without damage"); Ex. 1018, 2955, 2962 (explaining that "outstanding flexibility makes the Ag NW [silver nanowire] electrode attractive for flexible electronics," such as "capacitive touch screens."); Ex. 1019, ¶¶ [0025], [0033], [0081] (describing the "favorable physical and mechanical properties" of "robust and flexible" silver nanowire matrices for use in "touch screens"); Ex. 1023, ¶ 183.

Therefore, a POSA would have recognized this modification to be nothing more than the "application of a known technique [wrapping a touch sensor around the edge of a touchscreen device's display] to a piece of prior art ready for the improvement [Moran]." *KSR*, 500 U.S. at 417.

7[f]: "one or more computer-readable non-transitory storage media embodying logic that is configured when executed to control the touch sensor."

A POSA would have recognized that Moran discloses logic that is stored in memory or other circuitry that is configured to control its capacitive touch sensor, which satisfies this claim element. Moran discloses that the conductive micropatterns are connected to "signal processing, logic, memory, or other circuitry for the purpose of using the micropatterns as part of a system (e.g., driving the conductive micropatterns with electrical signals for the purpose of capacitively detecting the presence or location of a touch event to an information display)." Ex. 1007, 6:7–26; Ex. 1023, ¶ 184.

Using such logic and memory for the purpose of detecting touch presence or location would be understood as executing instructions ("logic") that is stored on ROM or other non-volatile memory (computer-readable non-transitory storage media). *See* Ex. 1023, ¶ 138, 184. Indeed, the '311 patent itself discloses that "a computer-readable storage medium may include a semiconductor-based or other ICs," Ex. 1001, 8:11–34. Thus, this element would be at a minimum obvious in view of Moran's disclosure. Ex. 1023, ¶ 184.

2. Claims 2 and 8

"The [apparatus of claim 1/device of claim 7], wherein the touch sensor further comprises tracking disposed on the substantially flexible substrate configured to provide drive or sense connections to or from the drive or sense electrodes

and configured to bend with the substantially flexible substrate.”

Moran discloses the “tracking” of this dependent claim element. Moran discloses that its conductive micropatterns (the claimed drive and sense electrodes, as discussed above) are “connected to . . . signal processing, logic, memory, or other circuitry,” Ex. 1007, 6:19–24, such as “first and second conductive trace regions 706 and 726” disposed on the substrate—the claimed tracking—as illustrated in Figs. 11–13 of Moran, *id.*, 30:24–29, 31:9–12, 32:10–12; Ex. 1023, ¶ 185:

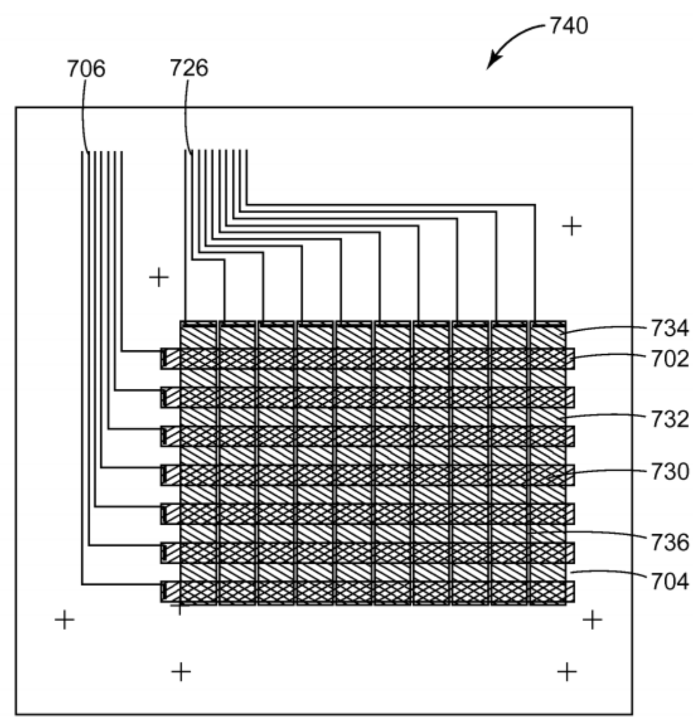


Fig. 13

Moran further discloses that the controlling circuitry “drives[s]” certain conductive micropattern sensors (the claimed drive electrodes) and “measure[s]” other conductive micropattern sensors (the claimed sense electrodes) in order to

"make mutual capacitance measurements of the transparent sensor element." Ex. 1007, 32:21–29; Ex. 1023, ¶ 186. And a POSA would have recognized that Moran's "conductive trace regions," like its mesh electrodes, would similarly bend with the substantially flexible PET substrate, as Moran discloses that its sensor is "substantially planar and flexible," Ex. 1007, 8:13–16, and contemporary prior art references such as Kuriki disclosed that such silver traces disposed on a PET substrate are flexible and configured to bend with the PET substrate, Ex. 1003, 11:64–12:8, 19:64–21:12, 27:48–28:38, 29:55–30:33, Fig. 15 at S106, Fig. 18; Ex. 1023, ¶ 187.

3. Claims 3 and 9

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines are made from one of carbon nanotubes, copper, silver, a copper-based material, or a silver-based material."

Moran discloses that the conductive lines of its "conductive micropattern" mesh electrodes may be made from silver or copper, and thus discloses this dependent claim element. Ex. 1007, 22:13–15; Ex. 1023, ¶ 188.

4. Claims 4 and 10

"The [apparatus of claim 1/device of claim 7], wherein the touch sensor comprises: a single-layer configuration with drive and sense electrodes disposed only on a first surface of the substantially flexible substrate; or a two-layer configuration with drive electrodes disposed on the first surface of the substantially flexible substrate and sense

electrodes disposed on a second surface of the substrate opposite the first surface."

Moran discloses that its touch sensor may have a single-layer configuration where both drive and sense electrodes are disposed on the same surface of the substantially flexible substrate. Specifically, Moran discloses that "[t]he second conductive micropattern may be disposed on the same substrate as the first conductive micropattern," Ex. 1007, 8:29–9:5, and that these conductive micropatterns are "patterned onto the surface of the substrate in a mesh geometry . . . provided that the second conductive micropattern . . . is electrically isolated from the first conductive micropattern," *id.*, 6:7–26; Ex. 1023, ¶ 189.

5. Claims 5 and 11

"The [apparatus of claim 1/device of claim 7], wherein the touch sensor is a mutual-capacitance touch sensor or a self-capacitance touch sensor."

Moran satisfies this dependent claim element, disclosing that its touch sensor is a mutual-capacitance sensor that "make[s] mutual capacitance measurements." Ex. 1007, 32:21–22; Ex. 1023, ¶ 190.

6. Claims 6 and 12

"The [apparatus of claim 1/device of claim 7], wherein the touch sensor further comprises electrically-isolated structures made of conductive material comprising a conductive mesh."

Moran satisfies this dependent claim element, disclosing that electrically "isolated squares of conductor" may be patterned onto the substrate in areas between

mesh electrodes to ensure "uniformity of light transmittance across the sensor" (i.e., to ensure the underlying display has a uniform appearance to the human eye). Ex. 1007, 20:15–31. Fig 10 of Moran, for example, discloses "mesh bars 441 that are electrically isolated from the electronic device" and "serve to maintain optical uniformity across the sensor," *id.*, 28:3–25; Ex. 1023, ¶ 191:

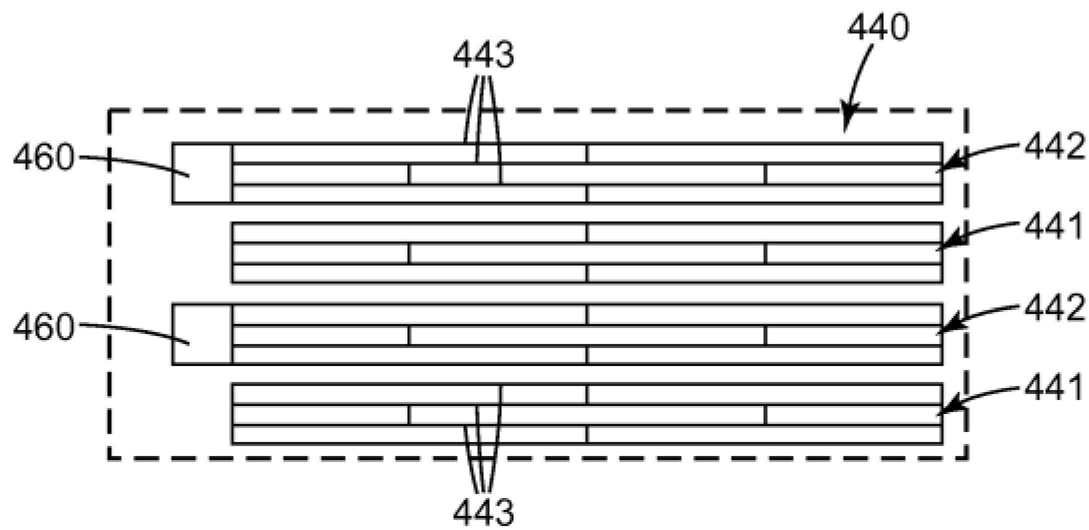


Fig. 10

7. Claims 13 and 16

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines are substantially orthogonal to one another."

Moran satisfies this dependent claim element, disclosing that the first and second conductive lines of its mesh electrodes are substantially orthogonal to one another, as shown (for example) in Figure 2, Ex. 1023, ¶ 192:

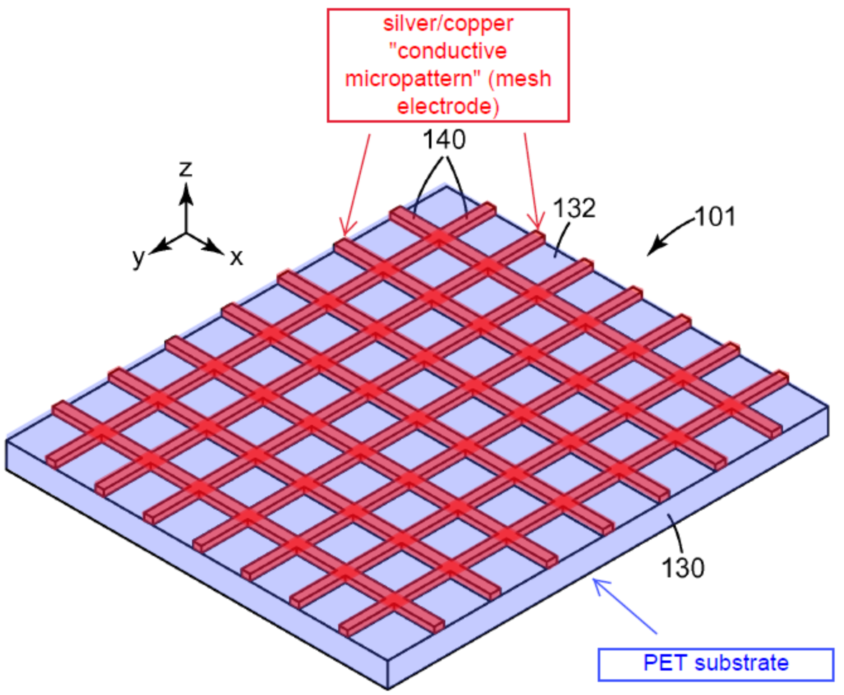


Fig. 2

8. Claims 15 and 18

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines are made of fine lines of metal having a thickness of approximately 5 micrometers or less and a width of approximately 10 micrometers or less."

Moran satisfies this dependent claim element, disclosing that the conductive lines of its mesh electrodes may be made from silver or copper, Ex. 1007, 22:13–15, that the preferred values for "the minimum dimension of the conductive pattern elements (e.g., the width of a line or conductive trace)" in its mesh electrodes "are between 0.5 and 5 micrometers, more preferably between 1 and 4 micrometers, and most preferably between 1 and 3 micrometers," *id.*, 12:7–30, and that "the (e.g. metal)

micropattern" of its mesh electrodes "is relatively thin, ranging in thickness from about 5 nanometers to about 50 nanometers," *id.*, 22:27–23:4; Ex. 1023, ¶ 193.

E. Ground V: Claims 14 and 17 Are Unpatentable Under 35 U.S.C. § 103 Over the Combination of Moran, Joo, and Philipp.

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines are non-linear."

As explained above in Section VI.C, Philipp discloses these claim limitations. And also as explained above in Section VI.C, Philipp provides an express teaching, suggestion, or motivation to implement Philipp's non-linear conductive lines in Moran's mesh electrodes: "to avoid creating moiré patterns between the display and the touchscreen," Ex. 1005, Abstract, ¶¶ [0006], [0030]–[0031] ("wavy lines are used to avoid long linear stretches of fine metal line, reducing the probability of causing interference patterns"), [0042]; Ex. 1023, ¶ 198. Moran similarly notes concerns about "minimizing interference such as moire effects." Ex. 1007, 12:15–18; Ex. 1023, ¶ 198.

Furthermore, a POSA would have had a reasonable expectation of success in incorporating Philipp's teachings of non-linear conductive lines in Moran's mesh electrodes. Philipp, like Moran, is directed to mesh electrodes for use in capacitive touch sensors. Ex. 1005, ¶¶ [0018]–[0019], [0042], Fig. 4; Ex. 1023, ¶ 199. And Moran expressly discloses that its mesh electrodes can have "wavy or irregular linear traces." Ex. 1007, 9:32–10:3; Ex. 1023, ¶ 199. Accordingly, incorporating Philipp's

teachings of non-linear lines in this manner constitutes nothing more than "application of a known technique [Philipp's non-linear conductive lines] to a piece of prior art ready for the improvement [Moran's mesh electrodes]." *KSR,* 550 U.S. at 417.

F. Ground VI: Claims 19 and 20 Are Unpatentable Under 35 U.S.C. § 103 Over the Combination of Moran, Joo, and Rappoport.

"The [apparatus of claim 1/device of claim 7], wherein the first and second conductive lines of the flexible conductive material of the drive or sense electrodes is wider at the one or more edges of the display."

As explained above in Section VI.D, Rappoport discloses these claim limitations. Further, it would have been obvious to a POSA to apply Rappoport's technique—making conductive metal lines wider at the edge of a display—to the conductive lines of Moran's metal mesh electrodes (as modified by Joo). Ex. 1023, ¶¶ 200–204.

***Motivation to Combine*:** Rappoport provides an express teaching, suggestion, or motivation to implement this modification: to "help ensure that traces 62 are not cracked or otherwise damaged" when bent around the edge. Ex. 1006, ¶ [0043]; Ex. 1023, ¶¶ 205.

***Reasonable Expectation of Success*:** Rappoport, like Moran and Joo, is directed to devices with touchscreen sensors overlaying a display. Ex. 1006, ¶¶ [0029], [0049]; Ex. 1023, ¶ 206 (citing Ex. 1003, 21:55–65). Accordingly, use

of Rappoport's technique of making conductive lines wider into Moran's electrodes would be nothing more than "application of a known technique [making conductive lines wider at the edge of a display] to a piece of prior art ready for the improvement [Moran's mesh electrodes]." *KSR*, 550 U.S. at 417.

IX. CONCLUSION

Petitioner respectfully requests *inter partes* review and cancellation of claims 1–20 of the '311 patent.

Date: September 30, 2019

Respectfully submitted,

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CERTIFICATION UNDER 37 C.F.R. § 42.24(D)

I certify that the foregoing complies with the type-volume limitation of 37 C.F.R. § 42.24 and contains 13,991 words based on the word count indicated by the word-processing system used to prepare the paper, and excluding those portions exempted by § 42.24(a).

Date: September 30, 2019

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6 and 42.105, I certify that the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 9,256,311 Under 35 U.S.C. §§ 311–319 and 37 C.F.R. § 42.100 *et seq.*, together with Petitioner's Exhibits Nos. 1001–1024, was served by FedEx, a means at least as fast and reliable as Priority Mail Express®, on the following correspondence address of record for patent owner:

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